

# Pest Management in Wisconsin Field Crops

**A guide to managing weeds, insects, and diseases  
in corn, soybean, forages, and small grains**



Ryan Dewerff  
Emily Bick  
Patrick J. Liesch  
Glenn Nice  
Mark Renz  
Damon Smith  
Rodrigo Werle

# 2024



## Pesticide references and updates

References to pesticide products in this publication are for your convenience and are not an endorsement or criticism of one product over other similar products. You are responsible for using pesticides according to the manufacturer's current label directions. Follow directions exactly to protect the environment and people from pesticide exposure. Failure to do so violates the law.

Note also that this publication is not a complete list of all pesticide labels. Several pesticides are marketed in numerous formulations, and the common names of their active ingredients (e.g., atrazine, glyphosate, 2,4-D) are generally recognizable. In previous years, these pesticides were referenced by their common names. The publication now only refers to specific products and avoids making general comments with respect to an active ingredient. This change was made because the manufacturer decides many of a product's restrictions and regulations. In many cases, various registrants for the same product have the same regulations and restrictions, but in an increasing number of cases, those regulations and restrictions differ. To avoid any confusion, products are now only listing the primary registrant(s) for products. Much of the information will be correct across multiple manufacturers, but please refer to the label if using a product different than the ones referenced in this document.

**For updates throughout the growing season,** consult the Wisconsin Crop Manager newsletter, available online at [ipcm.wisc.edu/wcm](http://ipcm.wisc.edu/wcm)

**Current pesticide labels** are available online at [www.cdms.net/LabelsMsds/LMDefault.aspx](http://www.cdms.net/LabelsMsds/LMDefault.aspx)

**Measurements used in this publication vary** according to common usage. In most cases, U.S. customary units (ounces, miles, etc.) are used, and values are expressed in decimals rather than fractions. In a few instances, metric units and/or fractions have been retained to avoid confusion.



# Contents

## 1 Pest management and pesticides.....1

Integrated pest management .....	2
Federal pesticide-use law.....	2
Wisconsin's training and certification program .....	2
Wisconsin pesticide laws and regulations .....	3
Pesticides and community right-to-know.....	3
Worker Protection Standard (WPS) for agricultural pesticides .....	3
Oral notification and posting.....	3
Table 1-1. Examples of agricultural chemicals subject to Title III of SARA .....	4
Restricted entry interval (REI) .....	4
Pesticide tolerance levels .....	4
Pesticide toxicity .....	4
Human poisoning.....	4
Table 1-2. Toxicity categories of pesticides [Label Review Manual: Chapter 7. EPA July 2014].....	5
Pesticide safety .....	5
Pesticide accidents .....	5
Pesticides and endangered species .....	6
Pesticide drift .....	6
Pesticides and groundwater .....	6
Calibrating pesticide equipment .....	7
Cleaning pesticide sprayers.....	7
Preparing pesticide sprayers for storage.....	7
Pesticide disposal.....	8
A final word .....	8

## Weed management principles for all crops.....9

Selecting a weed management program .....	9
When to apply herbicides.....	9
Can herbicide rates be reduced? .....	9
Mixing herbicides.....	10
Herbicide/fertilizer combinations.....	10
Weather and herbicides .....	10
Herbicide residues in soil.....	10
Herbicides and conservation tillage .....	11
Herbicide-resistant weeds.....	11



Using new herbicides .....	12
Selecting herbicides .....	12
Table 1-3. Listing of herbicides by mode (site) of action.....	12

## **Fungicide resistance management principles ... 15**

FRAC Code 1 .....	15
FRAC Code 3 .....	15
FRAC Code 7 .....	15
FRAC Code 11 .....	15
FRAC Code 29 .....	16
FRAC Code P7 .....	16
FRAC Code M .....	16
FRAC Code U .....	16
Fungicide resistance management.....	16

# **2 Corn pest management..... 17**

## **Corn weed management..... 18**

Atrazine rate limits and restrictions .....	18
Burndown herbicides for no-till corn .....	18
Table 2-1. Atrazine active ingredient rate limits.....	18
Table 2-2. Wisconsin rate limits for products containing atrazine .....	19
Terminating corn stands for replant .....	19
Corn herbicides .....	19
Table 2-3a. Weed control ratings of corn herbicides applied preplant/preemergence .....	20
Table 2-3b. Cautionary statements for corn herbicides applied <u>before</u> corn emergence .....	22
Table 2-3c. Weed control ratings of corn herbicides applied postemergence .....	23
Table 2-3d. Cautionary statements for corn herbicides applied <u>after</u> corn emergence .....	25
Table 2-4. Forage, grazing, and grain harvest intervals for corn herbicides .....	42
Table 2-5. Rate equivalents of corn herbicide premixes.....	43
Table 2-6. Rainfree period and adjuvants required for postemergence corn herbicides.....	44

## **Corn insect management..... 47**

Predicting soil insect control needs for corn .....	47
Insect pests .....	48
Table 2-7. Guide to black cutworm development and damage in corn.....	51
Table 2-8. Economic thresholds for stalk borer in corn, based on leaf stage, market value and expected yield 54	
Bt sprays and transgenic Bt corn for insect control .....	55
Table 2-9. Handy Bt Table.....	57
Insecticide suggestions for corn pests .....	59



## Corn disease management ..... 81

Disease management strategies .....	81
Disease problems .....	82
Table 2-10. Fungicide efficacy for leaf diseases of field corn (hybrid seed production and grain) .....	83
Table 2-11. Nematode genera associated with corn in Wisconsin .....	90
Table 2-12. Corn nematode populations associated with yield loss .....	91
Table 2-13. Directory of nematology laboratories .....	92
Table 2-14. Directory of mycotoxin laboratories .....	93
Table 2-15. Some mycotoxins and their effects .....	93
Table 2-16. Max. time for storage of shelled corn at various corn moisture and air temperatures .....	94
Table 2-17. General guide for sampling stored grain .....	95

## 3 Soybean pest management ..... 97

### Soybean weed management ..... 98

Burndown herbicides for no-till soybean .....	98
PRE-emergence herbicides .....	98
Table 3-1a. Weed control ratings of soybean herbicides applied before emergence or via pre plant incorporation .....	99
Table 3-1b. Weed control ratings of soybean herbicides applied after soybean emergence .....	101
Soybean herbicides .....	103
Table 3-2. Rate equivalents of soybean herbicide premixes .....	117
Table 3-3. Forage and grain harvest intervals for soybean herbicides .....	118
Table 3-4. Rainfree period and adjuvants required for postemergence soybean herbicides .....	119

### Soybean insect management ..... 120

Insect pests .....	120
Table 3-5. Bean leaf beetle threshold for overwintering adults (per plant) in soybean .....	121
Table 3-6a. Bean leaf beetle threshold for first generation adults (per 20 sweeps) .....	121
Table 3-6b. Bean leaf beetle threshold for second generation adults (per 20 sweeps) .....	121
Table 3-7. Treatment decision guidelines for two-spotted spider mites .....	125

### Soybean disease management ..... 138

Resistant or tolerant varieties .....	138
Crop management .....	138
Fungicides .....	138
Soybean diseases .....	139
Table 3-8. Fungicides for treating soybean seeds for protection against Fusarium, Rhizoctonia, Pythium, Phytophthora, and Phomopsis .....	140
Table 3-9. Risk assessment of soybean cyst nematode (SCN) by soil population and soil type .....	145
Table 3-10. Fungicide efficacy ratings for foliar soybean diseases in Wisconsin .....	147
Table 3-11. Management recommendations for Sclerotinia stem rot (white mold) .....	152



## 4 Forage and pasture pest management 153

### Forage and pasture weed management ..... 154

Forage legumes.....	154
Establishing forage legumes without a cover crop (direct seeding).....	154
Table 4-1. Impact of common weeds on forage quality.....	154
Table 4-2a. Seedling legume tolerance and herbicide effectiveness on weeds commonly found in establishing legumes seeded without a cover crop .....	155
Table 4-2b. Cautionary statements for herbicides of commonly found weeds in establishing legumes seeded without a cover crop .....	155
Herbicides for establishing alfalfa .....	156
Summer seedings .....	158
Weed management in established forage legumes .....	158
Herbicides for established alfalfa .....	158
Weed and brush control in grass pastures .....	160
Table 4-3a. Legume tolerance and herbicide effectiveness on weeds commonly found in established legume stands .....	161
Table 4-3b. Cautionary statements for herbicides of commonly found weeds in established legume stands .....	161
Table 4-4. Herbicide effectiveness on weeds commonly found in pastures .....	164
Table 4-5. Harvest and/or grazing restrictions for herbicides registered for use in forages/pastures ..	167
Pasture renovation .....	167

### Forage and pasture insect management ..... 170

Reducing insecticide hazards to bees .....	170
Table 4-6. Periods to scout for insect pests of forages.....	170
Alfalfa insects .....	171
Table 4-7. Treatment thresholds for potato leafhoppers on alfalfa .....	172
Insect pests of birdsfoot trefoil, clover, and pasture .....	173
Table 4-8. Insecticide suggestions for birdsfoot trefoil, clover, pasture, and rangeland.....	173
Insecticide suggestions for alfalfa .....	175

### Forage disease management ..... 182

Alfalfa leaf and stem diseases .....	182
Alfalfa seedling diseases .....	182
Alfalfa root and crown diseases.....	182
Table 4-9. Fungicides registered for foliar alfalfa diseases in Wisconsin.....	183
Table 4-10. Probability and occurrence of alfalfa diseases in stands of different ages .....	184
Table 4-11. Seed treatment fungicides for alfalfa diseases.....	185
Red clover diseases .....	186
Diseases of forage grasses .....	186



## 5 Small grains pest management .... 187

### Small grains weed management ..... 188

Herbicides for small grains with a legume seeding .....	188
Figure 5-1. Herbicide application periods at various growth stages of small grains (Feekes scale) .....	189
Table 5-1. Crop registration, tolerance, and herbicide effectiveness on weeds commonly found in small grains .....	190
Herbicides for small grains without a legume seeding .....	191
Table 5-2. Harvest and/or grazing restrictions for herbicides registered for use in small grains .....	194

### Small grains insect management ..... 195

Insect pests of small grains .....	195
Table 5-3. Treatment thresholds for aphids to prevent direct plant damage (not disease reduction) and subsequent grain yield loss .....	195

### Small grains disease management ..... 199

Small grain diseases .....	199
Table 5-4. Fungicides for control of foliar diseases of small grains.....	201
Table 5-5. Seed treatment fungicides for small grains .....	208

## 6 Stored grain insect management.. 209

### Stored grain insect management ..... 210

Bin preparation .....	210
Empty bin treatments .....	210
Grain protection with insecticides .....	211
Grain surface treatments.....	213
Indian meal moth .....	214
Grain inspection .....	214
Table 6-1. The number of live insects required for FGIS designations as infested .....	215
Safety precautions .....	215
Controlling established infestations .....	215
Fumigation .....	215

## 7 Appendix ..... 217

Table 7-1. Herbicide products and related information .....	218
Table 7-2. Insecticide products and related information .....	223
Table 7-3. Fungicide products and related information .....	226
Table 7-4. Planting interval for rotational crops .....	230
Table 7-5. Herbicide effectiveness on listed invasive weeds in CRP fields .....	238
Useful UW-Madison, Division of Extension publications.....	240
University of Wisconsin-Madison websites .....	240

---

**Notes:**





# PRINCIPLES OF PEST MANAGEMENT

Corn weeds

Soybean

Forages &  
pastures

Small grains

Stored grain  
insects

Appendix

# Pest management and pesticides

Controlling a pest—be it a weed, an insect, or a disease—is only part of a total pest management program. Pest control is a corrective measure; you use pesticides or some other control method to reduce a damaging (or potentially damaging) pest population. Pest management, however, includes preventative measures as well.

The primary goal of a pest management program is to maintain an acceptable level of pest damage. Eradication of pests is rarely possible or feasible. In fact, our eradication attempts may create more problems (e.g., pesticide resistance, secondary pest outbreaks) than they solve. Pesticides are vital, effective tools for agriculture and for food and fiber production, but they are not a cure-all for all pest problems. Rather, they must be viewed in the context of a total pest management program.

## Integrated pest management

Integrated pest management (IPM) is the coordinated use of multiple pest control methods. By becoming familiar with the crop, the pest, and all available control tactics, you can develop and implement a sound IPM program that will help you apply pesticides only when necessary.

## Federal pesticide-use law

When Congress amended the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) in 1972, it included a mandate for the Environmental Protection Agency (EPA) to evaluate all new and existing pesticide products for potential harm they may cause. It also made it illegal to use, except as provided by FIFRA, any pesticide in a manner inconsistent with its labeling. Deviations from the

label not recognized by FIFRA are a violation of the law.

The Food Quality Protection Act (FQPA) of 1996 strengthens the system that regulates pesticide residues on food. Recognizing that pesticide residues are present in more sources than just food, the FQPA sets limits on the total exposure from residues found in food, drinking water, and nondietary sources (such as household, landscape, and pet uses). As a result, the more uses a particular pesticide has, the greater the chance its total exposure will be met and, thus, some or all of its uses will be cancelled.

If, during the pesticide registration process, the EPA finds a product to generally cause unreasonable adverse effects on the environment—including increased risk of injury to the untrained applicator—it will be classified as restricted-use. Because restricted-use products can be used only by certified applicators, the FIFRA amendments also called for each state to develop a program for training and certifying pesticide applicators. The certification program is designed to ensure that users of restricted-use products are properly qualified to handle and apply these materials safely and efficiently. A current list of restricted-use pesticides registered for use in Wisconsin may be downloaded from the University of Wisconsin Pesticide Applicator Training (PAT) website (<https://fyi.extension.wisc.edu/pat/private-tools-and-information/>) under Government Tools.

## Wisconsin's training and certification program

In Wisconsin, responsibility for training lies with the University of Wisconsin—Madison Division of Extension PAT program, while actual certification is the responsibility of the Wisconsin

Department of Agriculture, Trade, and Consumer Protection (WDATCP). The Wisconsin Pesticide Law requires that all those using restricted use pesticides and all commercial applicators for hire participate in the training and certification process if they intend to use any pesticide in the state of Wisconsin, whether or not it is restricted-use.

The training prepares the applicators for the written certification exam administered by the WDATCP, which enforces Wisconsin's pesticide regulations and assures a competent understanding of the use of pesticides.

The selection, use, and potential risks of pesticides vary depending on the application method and what it is you want to protect from pests. Therefore, there is a separate training manual and certification exam for 21 pest control categories, including categories for: agricultural producers, the agricultural industry (10 categories), in and around commercial and residential buildings (6 categories), in right-of-way and surface waters (3 categories), and preserving wood. Certification is valid for 5 years, after which you can recertify by passing an exam based on a revised training manual. The regulated community—including pesticide manufacturers, dealers, and applicators—strongly support training and certification as a way to protect people and the environment while ensuring that pesticides remain an option in pest management. We encourage all applicators to take advantage of the training and certification process, whether or not you use restricted-use pesticides. For information about the Wisconsin PAT program, visit <https://fyi.extension.wisc.edu/pat>. For information on Wisconsin's licensing and certification program, search for "pesticide certification" on [https://datcp.wi.gov/Pages/Licenses\\_Permits/CommercialApplicator.aspx](https://datcp.wi.gov/Pages/Licenses_Permits/CommercialApplicator.aspx).

## Wisconsin pesticide laws and regulations

Operating under the provisions of the Wisconsin Pesticide Law and Administrative Rule, Chapter ATCP 29 (Register, April 2009), the WDATCP has primary responsibility for pesticide use and control in the state. The Wisconsin Department of Natural Resources (WDNR) has responsibility for pesticide use involving “waters of the state,” the control of birds and mammals, and pesticide and container disposal. The Wisconsin Division of Emergency Management (WDEM) has responsibility for helping communities evaluate their preparedness for responding to accidental releases of hazardous compounds, including pesticides, under Title III of the EPA’s Superfund Amendments and Reauthorization Act (SARA). The Wisconsin Department of Transportation (WDOT) has responsibility for regulating the transportation of pesticides listed as hazardous materials (shipping papers, vehicle placarding, etc.), and for issuing commercial driver’s licenses. It is your responsibility to become familiar with all pertinent laws and regulations affecting pesticide use in Wisconsin.

### Pesticides and community right-to-know

To help communities evaluate their preparedness for responding to chemical spills, Congress passed the Emergency Planning and Community Right-to-Know Act (EPCRA). This law is part of a much larger legislation called the Superfund Amendments and Reauthorization Act (SARA) and is often referred to as Title III of SARA. Title III sets forth requirements for reporting of hazardous substances stored in the community and for developing an emergency response plan.

The first step in emergency planning is to know which chemicals can cause health problems and environmental damage if accidentally released. The EPA prepared a list of extremely haz-

ardous chemicals. These substances are subject to emergency planning and the threshold planning quantity, the smallest amount of a substance which must be reported. Some of the chemicals listed are commonly used in agricultural production (see table 1).

A complete list of EPA’s extremely hazardous substances is available from the Local Emergency Planning Committee (LEPC) in your county.

Any facility, including farms, that produces, uses, or stores any of these substances in a quantity at or greater than their threshold planning quantity must notify the WDEM and their LEPC that it is subject to the emergency planning notification requirements of Title III of SARA.

In addition to emergency planning notification, agricultural service businesses with one or more employees are subject to two community right-to-know reporting requirements: submission of safety data sheets (SDS) and submission of Tier II inventory forms. Tier II forms request specific information on each hazardous chemical stored at or above its threshold.

### Worker Protection Standard (WPS) for agricultural pesticides

The federal Worker Protection Standard (WPS) for Agricultural Pesticides took effect January 1, 1995 and was revised in 2015. Its purpose is to reduce the risk of employee exposure to pesticides. You are subject to the WPS if you have at least one non-family employee who is involved in the production of agricultural plants in a nursery, greenhouse, forest, or farming operation.

The WPS requires employers to do the following:

- Display pesticide safety information in a central location.
- Annually train uncertified workers and handlers on general pesticide safety principles.

- Provide personal protective clothing and equipment to employees.
- Provide a decontamination site (water, soap, towels, and coveralls).
- Provide transportation to an emergency medical facility for employees who are poisoned or injured by pesticide exposure.
- Maintain training and pesticide records for two years.
- Notify employees about pesticide applications (see below).
- Pesticide handlers (including mixing/loading) that are not family, must be a minimum of 18 years of age.

For more information about the WPS and the training requirements for uncertified workers and handlers, download the How to Comply With the 2015 Revised Worker Protection Standard for Agriculture Pesticides from the Pesticide Educational Resources Collaborative (PERC) website (<http://pesticideresources.org>). This website also has EPA-approved training videos for workers and handlers.

### Oral notification and posting

The WPS requires employers to give notice of pesticide applications to all workers who will be in a treated area or walk within 0.25 miles of a treated area during the pesticide application or during the restricted entry interval (described below). Notification may either be oral warnings or posting of warning signs at entrances to treated sites; both are necessary if the label requires dual (oral and posting) notification. Dual-notice pesticides can be identified on the label by checking the Agricultural Use Requirements box. This box provides instructions for oral and posting requirements. A current list of dual-notice pesticides registered for use in Wisconsin may be downloaded at <https://fyi.extension.wisc.edu/pat/pat-tools> under PAT Tools.

Wisconsin’s Agriculture, Trade & Consumer Protection (ATCP) 29 posting

rule is designed to protect the general public as well as workers. Thus, it requires posting of areas treated with pesticides having a dual notification statement or, for nonagricultural pesticide applications, if the label prescribes a restricted entry interval for that particular application. Refer to On-Farm Posting of Pesticide-Treated Sites in Wisconsin for a flow chart guiding users through a series of questions to determine when posting of treated sites is needed, what warning sign to use, and where the sign should be located. Also covered are the separate posting requirements for chemigation treatments. This publication is available online at <https://fyi.extension.wisc.edu/pat/pat-tools> under PAT Tools. Or you can use the PAT program's online posting tool (<https://s3-us-west-2.amazonaws.com/pat-tools.cals.wisc.edu/tools/Posting/index.html>) to identify what signs must be posted and when.

## Restricted entry interval (REI)

A restricted entry interval (REI) is the length of time that must expire after pesticide application before people can safely enter the treated site without using personal protective equipment. Pesticide residues on a treated crop or in a treated area may pose a significant hazard to workers or others who enter the area after treatment. Therefore, nearly all pesticides affected by the WPS (see above) have an REI. Check the Agricultural Use Requirements box on the label for the specific REI for your product. These intervals must be strictly observed.

## Pesticide tolerance levels

In Public Law 518, the Food and Drug Administration (FDA), a division of the

U.S. Department of Health and Human Services, warns "Food shipments bearing residues of pesticide chemicals in excess of established tolerances will be contraband and subject to seizures as adulterated." This applies to both raw and processed foods.

The amount of pesticide residue in or on a food material at harvest must fall into established tolerances, expressed in parts per million (ppm). The actual amount of pesticide chemical found in a food at harvest depends in part on the amount applied to the crop and the length of time since the last application. Therefore, growers are responsible for strictly following label information with regard to maximum spray dosage and the interval between the final pesticide application and harvest. The FDA advises pesticide users to follow directions on recently registered labels, so they don't exceed the residue tolerances for the specific materials.

## Pesticide toxicity

Pesticides enter the human body in four common ways: through the skin (dermal), the mouth (oral), the lungs (inhalation), and the eyes. Agricultural workers are most often poisoned by absorbing the pesticides through the skin.

Perhaps the greatest hazard for the applicator is in loading and mixing the pesticide concentrate, which presents a significant risk of exposure to the chemical in its most toxic form. Although hazards associated with the actual application are frequently much less severe, they can still be substantial, especially if there is significant drift or if appropriate precautions are ignored. A pesticide may be toxic as a result of exposure to a single dose (acute toxicity) or repeated exposures over time (chronic toxicity).

Increased attention has been given to the study of chronic effects in the past several years.

Acute toxicities are normally expressed as the amount of pesticide required to kill 50% of a population of test animals (usually rats or rabbits). For oral and dermal exposure, this is referred to as the LD50 or "lethal dose to 50%" in milligrams of toxicant per kilogram of body weight (mg/kg). For inhalation exposure, it is expressed as the LC50 or "lethal concentration to 50%" in parts per million (ppm) of toxicant in the total volume of air when the toxicant is a gas or vapor, and in milligrams per liter (mg/l) of air or water when the toxicant is a dust or mist. Pesticides with greater acute toxicities have lower LD50 and/or LC50 values; that is, it takes less of the chemical to kill 50% of the test population.

Labels indicate the relative level of acute toxicity through the use of signal words and symbols that reflect general categories of toxicity. The toxicity category is assigned on the basis of the highest measured toxicity, be it oral, dermal, or inhalation; effects on the eyes and external injury to the skin are also considered.

## Human poisoning

In the event of human pesticide poisoning, the pesticide label is your first source of first-aid information. Always bear in mind, however, that first-aid response to pesticide exposure is not a substitute for professional medical help. Seek medical attention promptly and always be sure to give the label or labeled container to the doctor. The product's Safety Data Sheet (SDS) is a more technical document than the label, and it often contains additional treatment instructions for the attending medical professional.

Poison Control Center (1-800-222-1222). You may call the Poison Control Center at any hour for information regarding proper treatment of pesticide poisoning. While hospitals and medical facilities may have some information, the Poison Control Center has

**Table 1-1.** Examples of agricultural chemicals subject to Title III of SARA

Active ingredient	Trade name	Threshold planning quantity (lb or gal of product)
Dimethoate	Dimethoate 4EC	125 gal
Paraquat	Gramoxone Inteon	5 gal

the most complete and current files, and their personnel are specifically trained to deal with poison cases.

## Pesticide safety

Before you handle pesticides, stop and read the label. Labels contain human safety precaution statements and list the specific protective clothing and equipment that you need to wear. Some of the following may be label requirements; others are common-sense guidelines that will help minimize pesticide exposure to you, your co-workers, and your family and neighbors.

- Wear a long-sleeved shirt, long trousers, shoes, and socks when handling pesticides.
- Wear coveralls (fabric or chemical resistant) over your work clothes for an added layer of protection.
- Unless the label states otherwise, always wear chemical-resistant gloves whenever you work with pesticides.
- Wear chemical-resistant footwear, gloves, eyewear, and a respirator (if the label requires one) when mixing, loading, or applying pesticides.
- If you wear fabric coveralls, also wear a chemical-resistant apron when mixing and loading pesticides.
- Stand in the crosswind when mixing or loading pesticides.
- Never apply pesticides when there is the likelihood of significant drift.
- Never leave a spray tank containing a pesticide unattended.
- Avoid back-siphoning into the water source.
- Never eat, drink, or smoke when handling pesticides.

- Wash hands thoroughly after handling pesticides.
- If you splash pesticide on yourself, remove contaminated clothing immediately and wash yourself thoroughly.
- Wash contaminated clothes separately from other household laundry.
- Discard clothes that have been saturated with pesticides—they cannot be completely cleaned.
- Keep pesticides in original containers.
- Store and lock pesticides out of the reach of children.
- Observe restricted entry intervals on a treated crop or area.

## Pesticide accidents

**Pesticide spills.** Regardless of the magnitude of a spill, the objectives of a proper response are the same—you must control the spill, you must contain it, and you must clean it up. A thorough knowledge of appropriate procedures will allow you to minimize the potential for adverse effects.

Report spills of any compound to the WDNR. However, you do not need to report the spill if it is completely confined within an impervious secondary containment and the spilled amount can be recovered with no discharge to the environment. On the other hand, a spill of any amount is reportable if it occurred outside of secondary containment and it harmed, or threatens to harm, human health or the environment (e.g., back siphoning). The spill is exempt from the WDNR reporting requirements if you deem the spill will not harm, or threaten to harm, human health or the environment and the amount spilled would cover less than 1 acre if applied at labeled rates and, if a SARA pesticide, is less than the reportable quantity. If unsure, err on the side of caution. You will not get into trouble for reporting a spill that does not need to be reported, but you can get into trouble

**Table 1-2.** Toxicity categories of pesticides [Label Review Manual: Chapter 7. EPA July 2014]

	Toxicity category			
	I High	II Moderate	III Slight	IV Low
Measure of toxicity	toxicity	toxicity	toxicity	toxicity
Oral LD <sub>50</sub> (mg/kg)	0–50	50–500	500–5,000	>5,000
Dermal LD <sub>50</sub> (mg/kg)	0–200	200–2,000	2,000–5,000	>5,000
Inhalation LC <sub>50</sub> dust/mist (mg/l)	0–0.05	0.05–0.5	0.5–2	>2
Eye effects	Corrosive (irreversible destruction of ocular tissue) or corneal involvement persisting for more than 21 days.	Corneal involvement or other eye irritation clearing in 8–21 days.	Corneal involvement or other eye irritation clearing in 7 days or less.	Minimal effects clearing in less than 24 hours.
Skin effects	Corrosive (tissue destruction into the dermis and/or scarring)	Severe irritation at 72 hours	Moderate irritation at 72 hours	Mild or slight irritation at 72 hours
Signal word	DANGER <sup>a</sup>	WARNING	CAUTION	CAUTION/ Not Required

Abbreviations: mg/kg = milligrams per kilogram; mg/l = milligrams per liter; ppm = parts per million; < = less than; > = greater than

<sup>a</sup> Products assigned to Category I due to oral, inhalation, or dermal toxicity (as distinct from eye and local skin effects) must also have the word “poison” and the skull and crossbones symbol on the label.

if you don't report a spill that needs to be reported.

Reportable spills involving SARA substances (see "Pesticides and Community Right-to-Know,") are also to be reported to the WDNR and to your LEPC. To simplify emergency notification requirements to state agencies, call the WDNR 24-hour spill hotline (1-800-943-0003) whenever a spill of any compound occurs. Calling this hotline will not, however, remove your responsibility of notifying your LEPC.

Spills of some compounds may require that you notify federal authorities by calling the National Response Center (1-800-424-8802). Your call to the WDNR spill hotline should provide you with assistance in determining whether federal authorities need to be notified.

**Pesticide fires.** In the event of a fire, call the fire department, isolate the area, and clear all personnel to a safe distance upwind from smoke and fumes. Always inform the fire department of the nature of the pesticides involved and of any specific information that may help them fight the fire and protect themselves and others from injury. For information on clean-up and decontamination, contact the WDEM and the pesticide manufacturer(s).

**Livestock poisoning.** When you suspect animal poisoning by pesticides, first call your veterinarian. If the cause of poisoning cannot be determined, call the WDATCP's Animal Toxic Response Team at 608-224-4500.

**Wildlife poisoning or water contamination.** Contact the WDNR district office. District offices are located in Spooner, Rhinelander, Eau Claire, Green Bay, Milwaukee, and Fitchburg.

## Pesticides and endangered species

Endangered and threatened species are the most vulnerable plants and animals in our natural communities. These species are either in danger of extinction or likely to become endan-

gered in the foreseeable future. Starting in 2010, the EPA's Endangered Species Protection Program (ESPP) will provide applicators with county specific bulletins containing pesticide limitations designed to better protect listed species and their habitat.

The first product to carry label text directing users to view a bulletin is methoxyfenozide (Intrepid 2F), to protect the endangered Karner blue butterfly and Hine's emerald dragonfly. It may take several years for products with the new label to replace the existing product in the market; always follow the product's label. Since then the new dicamba products labeled for over the top of Xtends soybean have received a bulletin. Expect more of these in the near future.

When using pesticides whose label statements instruct you to follow the measures contained in the ESPP Bulletin, you must either access the EPA's Bulletins Live! website or call their toll-free number (800-447-3813) within 6 months before using the product. This notification can be found in the Environmental Hazards section of the products label. The bulletin will show which counties or portions of counties are affected and the use limitations for that particular product. You must use the bulletin that is valid for the month and year in which you will apply the product.

Go to [epa.gov/endangered-species](https://epa.gov/endangered-species) for general information on the ESPP. The WDNR is responsible for implementing ESPP for our state. For more information about protected plants, animals, and natural communities in Wisconsin, see <https://dnr.wisconsin.gov/topic/%C2%ADendangeredresources/biodiversity.html>.

## Pesticide drift

It is impossible to totally eliminate pesticide drift. Drift occurs because of unforeseen wind variations and other factors, many of which are beyond the applicator's control. People living in areas subject to pesticide drift worry about the acute and chronic effects of exposure to pesticides. State rules

governing pesticide drift attempt to strike a balance between the intended benefits of pesticide use and the potential risks to those exposed to drift.

According to state law, people living adjacent to land that is aerially sprayed with pesticides can request to be notified at least 24 hours before application. Beekeepers can request notification of applications that occur within a 1.5-mile radius of their honeybee colonies. Both ground and aerial pesticide applications are subject to advance notification requirements to beekeepers who annually request such notification in writing.

For ground applications, you can minimize drift by following these recommendations:

- Follow all label precautions for specific drift-reduction measures.
- Spray when wind speed is low.
- Use the maximum nozzle orifice without sacrificing pest control activity.
- Keep pressure at the lowest setting possible without distorting spray pattern and distribution.
- Use drift-control agents when permitted by product label.
- Consider using nozzles specifically designed to reduce drift.
- Leave an untreated border strip next to adjacent property.

For more information about drift—what it is, how it occurs, and drift management principles—download *Managing Pesticide Drift: What Is It?* at [https://ipcm.wisc.edu/wp-content/uploads/sites/54/2022/11/PesticideDrift\\_final.pdf](https://ipcm.wisc.edu/wp-content/uploads/sites/54/2022/11/PesticideDrift_final.pdf). This publication also describes the critical role the pesticide applicator plays in deciding whether to spray at the site.

## Pesticides and groundwater

Trace amounts of pesticides are appearing in our nation's groundwater. To minimize further contamination,

tion, many pesticide labels contain precautionary statements either advising against or prohibiting use in areas vulnerable to groundwater contamination. A summary of these precautionary statements is included under “Remarks” for each pesticide in this publication.

To protect our state’s water resources, Wisconsin’s groundwater law (Act 310) created two guidelines to limit the presence of fertilizer and pesticides in groundwater: enforcement standards are maximum chemical levels allowed in groundwater and preventive action limits are set at a percentage of the enforcement standard. When contamination approaches preventive action limits, the responsible party must implement corrective measures to prevent further contamination. To get a list of fertilizers and pesticides and their enforcement standards and preventive action limits, see NR 140 ([docs.legis.wisconsin.gov/code/admin\\_code/nr/100/140](https://docs.legis.wisconsin.gov/code/admin_code/nr/100/140)).

Through groundwater monitoring studies, the most commonly found pesticide is atrazine. Consequently, Wisconsin implemented Chapter ATPC 30 to help minimize further contamination of our groundwater by atrazine. Under this rule, statewide rate restrictions have been implemented and, in some areas, the use of atrazine is prohibited.

### Mixing and loading pesticides.

Mixing and loading pesticides pose a high risk of point source contamination of ground and surface water because of the concentration, quantity, and type of pesticides that are usually handled at a mixing and loading site. To minimize this risk of environmental contamination, Wisconsin requires that certain mixing and loading sites have secondary containment.

Both private and commercial applicators are required to have a mixing and loading pad if more than 1,500 pounds of pesticide active ingredient are mixed or loaded at any one site in a calendar year or if mixing and loading occurs within 100 feet of a well or surface water. In-field mixing is exempt from the pad requirements

provided mixing or loading at the site of application occurs 100 feet or more from a well or surface water.

**Agricultural Chemical Cleanup Program.** Cleanup of contaminated soil or of contaminated groundwater itself is costly. The Agricultural Chemical Cleanup Program (ACCP) helps ease the financial burden for facilities and farms by reimbursing them for eligible costs associated with the cleanup of sites contaminated with pesticides or fertilizers. For more information, contact the WDATCP at 608-224-4518.

## Calibrating pesticide equipment

Accurate and uniform pesticide application is basic to satisfactory pest control. Too frequently a grower does not know exactly how much pesticide has been used until the application is completed. This can lead to substantial monetary losses due to unnecessary pesticide and labor costs, unsatisfactory pest control resulting in reduced yields, and crop damage. Good pesticide application begins with accurate sprayer or granular applicator calibration.

One method of calibration is contained in the Training Manual for the Private Pesticide Applicator and the Training Manual for the Private and Commercial Pesticide Applicator: Fruit Crops. These are available at <https://fyi.extension.wisc.edu/pat>.

## Cleaning pesticide sprayers

Thorough sprayer cleaning is necessary when switching from one pesticide type to another. This is especially important when herbicides are applied with the same equipment as fungicides or insecticides. If you apply significant quantities of different types of pesticides, reserve one sprayer for herbicides and another for insecticides and fungicides.

Check the label for specific cleaning instructions. If none are listed, follow the guidelines listed below:

- Park the sprayer on a wash pad and flush the tank, lines, and booms thoroughly with clean water and apply the pesticide-contaminated rinsate to sites listed on label. Simpler still, mount a clean water source on your sprayer and flush the system while in the field.
- Select the appropriate cleaning solution for the pesticide used: Hormone-type herbicides (e.g., 2,4-D, Banvel). Fill the sprayer with sufficient water to operate, adding 1 quart household ammonia for every 25 gallons of water. Circulate the ammonia solution through the sprayer system for 15–20 minutes and then discharge a small amount through the boom and nozzles. Let the solution stand for several hours, preferably overnight. (Please note: household ammonia will corrode aluminum sprayer part
- Other herbicides, insecticides, and fungicides. Fill the sprayer with sufficient water to operate adding 0.25–2 pounds powder detergent (liquid detergent may be substituted for powder at a rate to make a sudsy solution) for every 25–40 gallons of water. Circulate the detergent solution through the sprayer system for 5–10 minutes and then discharge a small amount through the boom and nozzles. Let the solution stand for several hours, preferably overnight.
- Flush the solution out of the spray tank and through the boom.
- Remove the nozzles, screens, and strainers and flush the system twice with clean water.
- Scrub all accessible parts with a stiff bristle brush.

## Preparing pesticide sprayers for storage

Before storing the sprayer at the end of the season:

- Clean the sprayer per label instructions or as specified above.
- Fill the sprayer with sufficient water to operate, adding 1–5 gallons of lightweight emulsifiable oil, depending upon the size of the tank. Circulate the oil/water solution through the sprayer system for 5–10 minutes.
- Flush the solution out of the spray tank and through the boom; the oil will leave a protective coating on the inside of the tank, pump, and plumbing.
- Remove the nozzles, screens, and strainers and place them in diesel fuel or kerosene to prevent corrosion. Cover the nozzle openings in the boom to prevent dirt from entering.
- As an added precaution to protect pumps, pour 1 tablespoon of radiator rust-inhibitor antifreeze in each of the inlet and outlet ports. Rotate the pump several revolutions to completely coat the interior surfaces.

## Pesticide disposal

It is the legal responsibility of all pesticide users to properly dispose of pesticide waste in an environmentally acceptable manner (it is illegal to bury or burn any pesticide containers in Wisconsin). Disposal is the final act of safe and judicious pesticide use. Some pesticides are considered “hazardous” by the EPA. Disposing waste or excess resulting from use of these pesticides comes under stringent regulations of the Resource Conservation Recovery Act (RCRA). This federal law and the accompanying state law (NR 600) regulate generators of hazardous waste, including those disposing of hazardous pesticides.

The simplest way to avoid becoming a hazardous-waste generator is to triple-rinse all pesticide containers and apply rinsates to labeled sites. If you must generate hazardous waste, disposal procedures may differ depend-

ing on the volume of waste generated and its characteristics.

You can reduce the amount of pesticide waste (hazardous or not) by following these guidelines:

- Determine whether the pesticide you intend to use is considered hazardous by the EPA. A list of these pesticides is available from your WDNR regional office. If listed, check for alternative pesticides that are not hazardous and will provide equivalent pest control.
- Mix only the amount of pesticide needed and calibrate equipment so all solution is applied.
- Attach a clean water supply to the sprayer unit so the tank can be rinsed and the rinsate applied to the labeled site while still in the field.
- Triple-rinse all pesticide containers. Even if the pesticides were hazardous, a triple-rinsed container is not hazardous waste, and you can dispose of it in a sanitary landfill.
- Don't mix hazardous waste with other pesticide waste. This will result in the entire mixture being considered hazardous.

### Wisconsin Clean Sweep program.

The Wisconsin Clean Sweep program, sponsored by the WDATCP and individual counties, offers a way to dispose of most kinds of pesticide waste including liquids, dry formulations, and hazardous waste. For details on when a site will be held in your area, check with your county Extension office or visit the WDATCP website (<https://datcp.wi.gov/Pages/Homepage.aspx>) and search for “clean sweep.” Wisconsin Clean Sweep has two components: an agriculture program and a household program.

**Recycling plastic pesticide containers.** Your local recycling program might recycle plastic pesticide containers. First, be sure to clean the containers in accordance with the pesticide label. Once the containers

are properly cleaned, contact your municipality to determine if it will recycle plastic pesticide containers. Each municipality decides whether or not it will accept plastic pesticide containers. Be aware that Wisconsin law prohibits the burning of pesticide containers regardless of the label's directions. Contact your pesticide supply dealer for additional container recycling options.

## A final word

Chemical pesticides help make disease, insect, and weed management programs successful. However, pesticides present hazards to agricultural workers, the general public, and the environment. Therefore, they should be used wisely, safely, and only when needed. Proper crop management can lessen the need for pesticide use, because a well-maintained planting is less susceptible to disease, insect, and weed pests.

**Note:** When applying a pesticide, always follow the directions on the label. Label information changes from time to time. The current pesticide label is the final authority for safety and legality.

# Weed management principles for all crops

The proper combination of cultural, mechanical, and chemical practices can maintain weeds at levels that are not economically damaging. The goal of cultural weed management is to allow a crop to compete vigorously with weeds. Crop competition is one of the most useful and economical methods of weed control. This is achieved by planting adapted varieties at the ideal density into a favorable seedbed that has adequate nutrients. Seeding forage legumes with a small grain companion crop is an excellent example of using crop competition to control weeds. The small grain germinates and grows quickly, preventing most weeds from becoming established.

Rotation to another crop is another essential component of sound weed management programs because certain weeds are more common in some crops than in others. A well-planned cropping system prevents the buildup of weeds associated with monocultures. Mechanical control such as tilling to prepare a weed-free seedbed, rotary hoeing, and row cultivation are effective and important components in many weed management programs.

Herbicides are highly effective in managing weeds if carefully selected to match the weed spectrum and applied in the appropriate manner following label restrictions. Still, the best herbicide and/or tillage program will not be effective without good crop competition.

## Selecting a weed management program

Plan your weed management program well in advance of the planting

season. Base it on thorough knowledge of the weed species, soil characteristics, and future cropping plans. As crop production practices change, weed problems also change, so a good weed management program must be flexible.

Herbicides vary in the types of plants they control. Some treatments control most broadleaf and grassy weeds, others control primarily annual grasses, and still others control only broadleaf weeds. Soil characteristics may affect herbicide performance and crop safety. Most soil-applied herbicides are less effective on soils high in organic matter and may be ineffective on peat and muck soils. Others should not be used on light-textured sandy soils, since they leach too readily and may damage crop seedlings. Still others interact with organophosphate insecticides to cause serious corn injury. Some herbicides remain in the soil into the next cropping season and injure sensitive crops. Check the rotational crop restrictions for the herbicides that you are considering to prevent injury to next year's crop.

## When to apply herbicides

Some herbicides must be soil-incorporated before planting for effective control. Others can be surface-applied before or after planting. Many herbicide treatments are registered for application after crop emergence.

Soil-incorporating herbicides are positioned where weed seeds are germinating and beginning growth. Some herbicides require incorporation to prevent loss through volatility or photo-decomposition. Proper herbicide incorporation is essential; check the herbicide label for recom-

mended tillage/incorporation tools and how deep and fast they should be operated. Although rainfall after preplant-incorporated herbicide application will improve weed control, it isn't required.

Early preplant- and preemergence-applied herbicides depend on rainfall to move them into the soil. Under Wisconsin conditions, spring rainfall is usually adequate to accomplish this. When rainfall is limited, a shallow tillage tool such as a rotary hoe or spike-toothed harrow can provide sufficient soil incorporation to activate the herbicide treatment and destroy the first flush of weed seedlings.

Many postemergence-applied herbicide options are available and have increased in use. The effectiveness of these treatments is drastically influenced by weed size as well as temperature, moisture, and other environmental conditions. Proper timing is critical with postemergence applications to optimize weed control and minimize the risk of crop injury.

## Can herbicide rates be reduced?

Producers are reevaluating their weed management practices and some are using lower herbicide rates than in the past. University of Wisconsin research has shown that application rates as much as 50% lower than the normal rates, combined with cultivation, can give excellent weed control. While the normal rate of a soil-applied herbicide often provides several months of weed control, reducing the rate shortens the length of control; successful full-season weed control with reduced rates often depends on a timely cultivation after planting

to control emerged weeds as well as a POST application. Reducing rates can be effective with both broadcast applications and banded treatments over the crop row.

If you are considering using reduced rates of herbicides, keep these factors in mind:

- It is legal to use less than the labeled rate of a pesticide. However, the manufacturer and commercial applicator are not liable for the performance under these conditions. You must be ready to manage weeds if and when needed to obtain effective full-season control.
- Try reducing the conventional rate 20-30% on a few acres the first year. As you gain confidence and experience with the system, you can adapt methods as needed.
- Do not consider reduced rates of soil-applied herbicides if you have hard-to-kill weeds like shattercane, wild proso millet, yellow nutsedge, or woolly cupgrass or herbicide-resistant weeds like waterhemp or giant ragweed. Also, reduced rates may not give satisfactory performance if your soils have more than 5% organic matter or high clay content.
- The safest way to cut herbicide use is to make banded applications. If you apply 10-inch bands over corn in 30-inch rows, then you'll apply 67% less herbicide in the field. You'll reduce the rate even more if the rate applied in the band is less than the conventional rate. Two timely cultivations normally give adequate control with banded treatments.

## Mixing herbicides

Using mixtures of two or more herbicides for simultaneous application has become popular in recent years. The objective of mixing herbicides is to capitalize on the advantages of all products while diminishing their disadvantages. Many such combinations have been registered for use.

Herbicide combinations that are not recommended on the label may cause crop injury or provide ineffective weed control.

When tank mixing wettable powder, liquid flowable, or dry flowable herbicides with emulsifiable concentrate herbicides, mix the wettable powder with the water or liquid fertilizer first. Then add water or liquid fertilizer until you've reached approximately 75% of the total spray volume you'll use. Add the emulsifiable concentrate last; then bring the mixture to final spray volume.

## Herbicide/fertilizer combinations

Herbicide application in liquid fertilizer solutions rather than water is popular. While such combination treatments save one trip over the field and enhance the burndown of existing weeds in conservation tillage, emerged corn is usually injured. Many individual herbicides and herbicide combinations are registered with the EPA for simultaneous application with liquid fertilizers. Herbicide labels and accompanying literature provide helpful mixing suggestions to minimize compatibility problems. If you have any doubt about the compatibility of a particular herbicide/fertilizer combination, run a compatibility test first. Adding compatibility agents such as Unite or Compex can reduce mixing problems. Wettable powder, liquid flowable, or dry flowable herbicides not properly mixed will sometimes float when mixed with liquid fertilizers. Emulsifiable concentrates occasionally cause mixing problems.

There also has been a trend toward impregnating herbicides on certain dry fertilizers. Some herbicides and herbicide combinations are registered with the EPA for this type of application. The herbicide manufacturer generally provides detailed directions and guidance for the impregnation process. Herbicide-impregnated fertilizer applications can provide weed control equal to comparable treatments applied as sprays. However, the herbicide/fertil-

izer blend and its application must be uniform, generally calling for a double spread or an airflow applicator.

## Weather and herbicides

Herbicides applied to the soil are taken up by roots, and stems of seedling weeds and by established perennial plants. Adequate rainfall is necessary to move surface-applied herbicides into the soil for maximum uptake by developing weed seedlings. Preplant soil-incorporated treatments position herbicide in the soil and minimize the need for rainfall to make them effective. Only certain herbicides can be used in this way; others become too diluted or increase the risk of injuring crops when mixed into the soil.

Adequate soil moisture also helps weed seeds germinate quickly, which is desirable when using soil-applied herbicides. However, excessive rainfall after herbicide application may leach the more soluble herbicides into the vicinity of germinating crop seeds and cause crop damage, especially on light, sandy soils. Chemical and microbial decomposition break down herbicides more slowly in cool, dry soils, thereby increasing the danger that some herbicides may carry over and injure sensitive crops the following year.

Weather conditions also affect postemergence herbicides. Generally, both weed and crop plant sensitivity increase with temperature. Lower herbicide or adjuvant rates are sometimes suggested in hot, humid weather to minimize crop injury. Weeds are more difficult to kill in dry, cool, or cloudy weather. Mature weeds are always more difficult to control than weed seedlings. Rainfall after postemergence application may reduce an herbicide's effectiveness. Check the product label or tables 2-6 (corn) and 3-4 (soybean) for the minimum required rain-free period.

## Herbicide residues in soil

Most herbicides control weeds only as long as the herbicides remain in the soil. Full-season weed control is

considered desirable for any herbicide treatment. But soil herbicide residue that persists after harvest or into the following growing season and damages the next crop is objectionable.

Following a few simple rules will reduce the risk of herbicide residue damage:

- Follow crop rotation guidelines listed on the herbicide product label. See appendix table 2 for a listing of rotational crop intervals for many common crops. Herbicides that have no carryover risk do not list rotation restrictions.
- Use the minimum recommended rate necessary for adequate weed control and apply the herbicide uniformly.
- Till treated fields before planting a sensitive crop the next year.
- At equal rates of the same herbicide, preplant or preemergence applications generally present less risk of carryover than postemergence applications. The earlier treatment allows more time for breakdown.
- Crops vary in their tolerance to carryover of specific herbicides. Select a crop that has a high degree of tolerance to the previous year's herbicide treatment or select an herbicide that will permit the planting of a rotation crop.

Several years of experience on a particular soil and an appreciation of environmental effects on herbicide carryover are the best guide to which crops you can safely plant the year after applying residual herbicide. Growers are encouraged to run a soil bioassay to determine whether harmful soil residues exist.

## Herbicides and conservation tillage

In conservation tillage systems, crop residue protects the soil surface from excessive raindrop impact and soil erosion. This surface debris can also affect weed seed germination and herbicide

distribution. Generally, surface residue of 3,000 pounds per acre or less (30% or less surface cover) does not interfere with herbicide performance. The key consideration of annual weed management in conservation tillage is that weed control may or may not be more difficult, but it probably will be different than in conventional systems.

## Herbicide-resistant weeds

Glyphosate-resistant giant ragweed has been confirmed in Rock County and have been anecdotally noted in additional fields in several other counties in the state. Also resistance to ALS-inhibitors has also been reported, but only one population of resistant giant ragweed has been confirmed in Columbia County. If you have heavy infestations of giant ragweed in corn and soybean fields, it is advised to implement a sound herbicide resistance management plan with diverse weed management tactics.

Also confirmed resistant to glyphosate are two population of horseweed (also known as maretail) in Jefferson and Columbia County. Horseweed, mostly problematic in no-till situations, is easily controlled by tillage as well as growth regulator herbicides (2,4-D or dicamba) in early preplant and post applications in corn.

Many populations of waterhemp are confirmed glyphosate-resistant in all regions of Wisconsin (total of 25 counties). This suggests widespread resistance throughout Wisconsin. While not tested, it is also assumed that many populations are also ALS resistant. Five counties (Grant, Iowa, Monroe, Pierce and Saint Croix) have reported resistance to PPO-inhibitors and glyphosate. This is common in many states to the south, and this type of multiple resistance is likely to spread in the future.

Glyphosate-resistant Palmer amaranth has been confirmed in Dane and Sauk County, while another population in Iowa county is confirmed resistant to ALS and HPPD inhibitors.

Additionally, biotypes of lambsquarters, smooth pigweed, velvetleaf, and kochia growing in Wisconsin are resistant to atrazine and other triazine herbicides. These problems developed after using triazine herbicides for six or more years without complementary control measures. This allowed the resistant biotype, initially a very small proportion of the total population, to produce seed and become the dominant biotype in many fields. Biotypes of weeds resistant to other herbicides have also been found in Wisconsin: giant foxtail and large crabgrass resistant to lipid synthesis inhibitors like Poast Plus, Select, and Assure; common ragweed, giant foxtail, eastern black nightshade, and kochia resistant to acetolactate synthase (ALS) inhibitors. Careful attention to sound weed management programs is critical if we hope to prevent the appearance of more herbicide-resistant biotypes. Comprehensive lists of herbicide-resistant weeds and other information can be found at <https://weeds science.org/Home.aspx>

The risk of developing more resistant weed problems is greater if herbicides that kill weeds by affecting only one physiological process in plants (that is, with a single mode of action) are overused. Table 1-3 lists the modes of action of most common herbicides and ranks them according to the risk of developing resistant weeds.

To minimize the risk of developing resistant weeds, a sound herbicide resistance management program uses a combination of these practices:

- Use herbicides only when necessary.
- Rotate herbicides with different modes of action from year to year. Herbicide labels now provide herbicide Group Numbers on the labels to help in rotating herbicides.
- Use multiple modes of action each year.
- Use broad crop rotations; three or four crops in rotation provide more

resistance protection than only two.

- Integrate mechanical control practices (rotary hoeing and cultivation) with herbicide use.
- Scout fields regularly and control escaping weeds as needed.
- Clean tillage and harvest equipment before moving from fields or farms with resistant weeds to other fields.

## Using new herbicides

The introduction of new herbicides invariably creates a good amount of grower interest. We encourage you to try new products that appear to fit your weed situation and soil condition but suggest you try them on a relatively small scale the first year.

## Selecting herbicides

The herbicide treatments described in the following sections have provided effective weed control under Wisconsin conditions. For corn and soybeans, review tables 2-3(a-d) and 3-1(a-b) to determine that herbicides will control the weeds in your fields. Then review the remarks in the herbicide entry to select the herbicide that best fits your situation. Tables that summarize rain-free periods and adjuvant requirements for postemergence herbicides, forage and grain harvest intervals, and rotational crop intervals are also included for easy reference.

All herbicide rates are expressed in weight or volume of commercial product as applied on a broadcast basis. See appendix table 7-1 for a list of herbicide products and related information.

**Table 1-3.** Listing of herbicides by mode (site) of action

Mode (site) of action	Group <sup>a</sup>	Herbicide	Active ingredient(s)
<b>Amino acid synthesis inhibitors</b> (ALS inhibitors)	2	Accent Q	nicosulfuron
		Affinity BroadSpec	thifensulfuron + tribenuron
		Ally/Escort	metsulfuron
		Arsenal	imazapyr
		Autumn Super	iodosulfuron + thiencazone
		Basis Blend	rimsulfuron + thifensulfuron
		Beacon	primisulfuron
		Canopy EX	chlorimuron + tribenuron
		Cimarron	metsulfuron
		Classic	chlorimuron
		Express	tribenuron
		FirstRate	cloransulam
		Harmony Extra SG	thifensulfuron + tribenuron
		Harmony SG	thifensulfuron
		Oust	sulfometuron
		Peak	prosulfuron
		Permit/Sandea	halosulfuron
		Plateau	imazapic
		Pursuit	imazethapyr
		Python	flumetsulam
		Raptor	imazamox
<b>Lipid synthesis inhibitors</b> (ACCase inhibitors)	1	Assure II/Targa	quizalofop
		Fusilade DX	fluzifop
		Fusion	fluzifop + fenoxaprop
		Poast Plus	sethoxydim
		Select Max/Arrow	clethodim
<b>Amino acid inhibitor</b> (EPSP synthase inhibitor)	9	Roundup, etc.	glyphosate

<sup>a</sup> Weed Science Society of America-approved group numbers for the corresponding herbicide site of action

<sup>b</sup> Diflufenzopyr is a growth regulator (auxin transport), group 19.

*Continued on next page*

**Table 1-3.** Listing of herbicides by mode (site) of action (continued)

Mode (site) of action	Group <sup>a</sup>	Herbicide	Active ingredient(s)
<b>Cell membrane disrupters</b> (PPO inhibitors)	<b>14</b>	Cadet	fluthiacet
		Cobra/Phoenix	lactofen
		Flexstar/Reflex	fomesafen
		Resource	flumiclorac
		Reviton	tiafenacil
		Sharpen	saflufenacil
		Spartan	sulfentrazone
		Starane	fluroxypyr
		Ultra Blazer	acifluorfen
		Valor SX	flumioxazin
<b>Cell membrane disrupters</b> (photosystem I electron diverters)	<b>22</b>	Gramoxone SL 3.0	paraquat
		Reglone	diquat
<b>Photosynthesis inhibitors — contact</b> (photosystem II inhibitors)	<b>6</b>	Basagran	bentazon
		Brox 2EC	bromoxynil
<b>Photosynthesis inhibitors — systemic</b> (photosystem II inhibitors)	<b>5</b>	AAtrex, etc.	atrazine
		Metribuzin, etc.	metribuzin
		Princep/Sim-trol	simazine
		Sinbar	terbacil
		Velpar L	hexazinone
	<b>7</b>	Lorox DX	linuron
		Spike	tebuthiuron
<b>Pigment inhibitors</b> (HPPD inhibitors)	<b>27</b>	Balance Flexx	isoxaflutole
		Callisto/Quartz	mesotrione
		Impact/Armezon	topramazone
		Laudis	tembotrione
		Shieldex 400SC	tolpyralate
<b>Pigment inhibitors</b> (diterpene synthesis inhibitor)	<b>13</b>	Command/Caravel	clomazone
<b>Seedling root growth inhibitors</b> (microtubule inhibitors)	<b>3</b>	Balan	benefin
		Prowl H <sub>2</sub> O, etc.	pendimethalin
		Treflan	trifluralin
<b>Nitrogen metabolism inhibitor</b> (glutamine synthesis inhibitor)	<b>10</b>	Liberty 280 SL, etc.	glufosinate

<sup>a</sup> Weed Science Society of America-approved group numbers for the corresponding herbicide site of action<sup>b</sup> Diflufenzopyr is a growth regulator (auxin transport), group 19.

Continued on next page

**Table 1-3.** Listing of herbicides by mode (site) of action (continued)

Mode (site) of action	Group <sup>a</sup>	Herbicide	Active ingredient(s)
<b>Growth regulators</b> (synthetic auxins)	<b>4</b>	Banvel/Clarity, etc.	dicamba
		Crossbow	triclopyr + 2,4-D
		Curtail	2,4-D + clopyralid
		ForeFront	aminopyralid + 2,4-D
		MCPA	MCPA
		Milestone	aminopyralid
		Starane	fluroxypyr
		Status	diflufenzopyr (19) <sup>b</sup> + dicamba
		Stinger	clopyralid
		Thistrol	MCPB
		Tordon	picloram
		Weedmaster	2,4-D + dicamba
		2,4-D	2,4-D
<b>Seedling shoot growth inhibitors</b> (long-chain fatty acid inhibitors)	<b>15</b>	Dual II Magnum/ Stalwart C	S-metolachlor/metolachlor
		Harness/Surpass, etc.	acetochlor
		Outlook	dimethenamid
		Zidua	pyroxasulfone
<b>Seedling shoot growth inhibitors</b> (lipid synthesis inhibitors [not ACCase inhibitors])	<b>8</b>	Eptam/Eradicane	EPTC
		Ro-Neet	cycloate

<sup>a</sup> Weed Science Society of America-approved group numbers for the corresponding herbicide site of action

<sup>b</sup> Diflufenzopyr is a growth regulator (auxin transport), group 19.

# Fungicide resistance management principles

**F**ungicide resistance (insensitivity to the fungicide) results from a complex interaction between fungicide mode of action, fungus biology, frequency of fungicide use, fungicide application, and cropping system. Care must be used when applying fungicides to reduce the risk of resistance.

The Fungicide Resistance Action Committee (FRAC) developed a code, known as the FRAC Code and available at [www.frac.info](http://www.frac.info), that can be used to classify fungicides into groups based on their modes of action. Foliar fungicides currently registered in Wisconsin for use on corn, soybean, alfalfa, and wheat fall into seven FRAC Codes: 1, 3, 7, 11, 29, P7, and M.

## FRAC Code 1

**The methyl benzimidazole carbamate (MBC) fungicide group contains the benzimidazole and thiophanate fungicide families.** These fungicides are effective against a broad range of fungi that cause leaf spots, root and crown rots, stem rots, and powdery mildews, but not rusts. MBC fungicides inhibit tubulin production, interfering with normal cell division in sensitive fungi. These fungicides have preventative and early-infection activity. While they have plant-penetrant properties, they cannot move down in the plant, making canopy penetration and complete plant coverage essential for control.

The modification of a single amino acid in a fungus can result in resistance. Resistance to these fungicides was first reported in 1970. Many important fungal plant pathogens have become resistant to these fungicides. **The MBC fungicide risk of resistance is HIGH.**

## FRAC Code 3

**The demethylation inhibitors (DMI) fungicide group contains the triazole fungicides.** DMI fungicides are highly effective against powdery mildews, rusts, and many leaf spotting fungi. These fungicides work by inhibiting a specific enzyme that plays a role in sterol production in fungi. Sterols are necessary for the development of functional cell membranes in fungi. Application of DMIs results in abnormal fungal growth and death. However, triazoles have no effect on spore germination because spores contain enough sterol for the formation of germ tubes. Thus, DMI fungicide must be applied preventively or at early infection to be effective. DMI fungicides are acropetal penetrant fungicides, meaning that they are taken up into the plant and can move short distances in the water-conducting elements (xylem) of plants. Generally, these fungicides have approximately 14 days of residual activity.

DMI fungicides have a very specific site of action, so risk of resistance development is a concern. Resistance management practices include avoiding repeated applications of DMI fungicides in the same season against high-risk pathogens such as powdery mildew. **The DMI fungicide risk of resistance is MEDIUM.**

## FRAC Code 7

**Succinate dehydrogenase inhibitors (SDHI) fungicides include several families such as the carboximides and benzamides.** Some common active ingredients used in field crops are boscalid, carboxin, and flutolanil. Boscalid is primarily a foliar fungicide used against the *Botrytis*, *Sclerotinia*, and *Alternaria* pathogens.

They work by inhibiting the respiration of target fungi, specifically complex II fungal respiration. SDHI fungicides are acropetal penetrant fungicides, meaning that they are taken up into the plant and can move short distances in the water-conducting elements (xylem) of plants. Resistance has been documented for these fungicides. **The SDHI fungicide risk of resistance is MEDIUM to HIGH.**

## FRAC Code 11

**The Quinone outside inhibitors (QoI) fungicide group contains three fungicide families: strobilurins, imidazoles, and oxazoles.** QoI fungicides are very effective against a broad spectrum of fungi. These fungicides work by inhibiting mitochondrial respiration, effectively stopping energy production of the fungus, and result in death. These fungicides are effective on spore germination and early growth. QoI fungicides vary on their mobility in plants. Some are local penetrants, while others are acropetal penetrants. Regardless of mobility in the plant, QoI fungicides are not effective against fungi that are growing inside the leaf tissue, so they must be applied preventively or at early infection to be effective. These fungicides have approximately 7-21 days of residual activity.

QoI fungicides have a very specific site of action, so the risk of resistance development is high. Currently there are more than 20 plant pathogens with some level of resistance to QoI fungicides. **The QoI fungicide risk of resistance is HIGH.**

## FRAC Code 29

**Oxidative Phosphorylation Uncoupler fungicides inhibit fungal respiration by disrupting the conversion of energy to a usable form.**

Fluazinam is an example of a common fungicide used to control white mold or Sclerotinia stem rot in crops such as potato and soybean. Fluazinam does inhibit the development of fungal infection structures and spore germination. Fluazinam is a contact fungicide and has little mobility within the plant. **The Oxidative Phosphorylation Uncoupler risk of fungicide resistance is LOW.**

## FRAC Code P7

**Fungicide active ingredients classified as salts of phosphorus acid in the group phosphonates have an unknown mode of action on fungi.**

Some studies suggest that the phosphite ion acts as an energy production inhibitor in fungi and oomycetes. The phosphite ion might also be responsible for triggering defense mechanisms in the plant. Recently fungicides containing potassium phosphite have been labeled for corn, soybeans, and small grains in Wisconsin. Potassium phosphite is considered a truly systemic fungicide, meaning it is translocated in the plant via the phloem and xylem (moving upward and downward in the plant).

**The phosphonates risk of fungicide resistance is LOW.**

## FRAC Code M

**Multi-site activity fungicides include inorganic compounds (M1), dithiocarbamates (M3), and chloronitriles (M5).** Multi-site activity fungicides have a broad spectrum of disease-control activity. They are contact fungicides and should be used preventatively since they are applied to the leaf and stem surfaces prior to pathogen appearance. They do not affect fungi once they have infected

the plant. Multi-site activity fungicides affect multiple biochemical sites in fungi, killing fungi by overwhelming them with toxins. These fungicides are sensitive to rainfall and sunlight since they are not absorbed into the plant, generally remaining active for 7-14 days.

Multi-site activity fungicides have a low risk of resistance development. Because of this, multi-site activity fungicides are an important part of fungicide resistance management. When multi-site fungicides are combined with either a code 3 or 11 fungicide (if allowed by the fungicide label), they may extend the number of years those higher risk fungicides can be used by reducing the number of applications of those high-risk fungicides. **The multi-site activity fungicide risk of resistance is LOW.**

## FRAC Code U

While this FRAC code appears infrequently in this book, the mode of action of some fungicides is unknown. In this case, a "U" is indicated to note that the mode of action is unknown.

## Fungicide resistance management

To reduce the risk of resistance, use the following guidelines.

- Plant disease-resistant hybrids/varieties whenever possible.
- Maintain proper soil fertility.
- Scout fields regularly, noting incidence and severity of diseases. Use this information to develop a field

history for future disease management decisions.

- Avoid sites with a history of high disease pressure.
- Utilize a crop rotation that fits your area and field history.
- Tank-mix high-risk fungicides with fungicides that have different modes of action, are active against the targeted disease(s), and have similar lengths of residual activity.
- Do not use reduced rates of fungicides.
- Alternate or tank-mix fungicides with different modes of action when multiple applications are required.
- Apply fungicides preventatively or early in the disease cycle and when a disease threat is warranted.
- Avoid curative fungicide applications, especially with high-risk fungicides.

**Always read and follow the pesticide label:**

- For maximum number of sprays per season.
- For recommended application rates.
- For application timing for both target disease and plant growth stage.

# CORN PEST MANAGEMENT

Soybean

Forages &  
pastures

Small grains

Stored grain  
insects

Appendix



# Corn weed management

Herbicide treatments are specific as to time and method of application, soil type, rate applied, and are weed species specific. Crops that follow in rotation are also important considerations. Failure to apply herbicides according to label directions can result in incomplete weed control, excessive crop injury, or damage to subsequent crops. If you don't get significant rainfall within 5-7 days after preemergence herbicide application, use a rotary hoe or spike-toothed harrow to incorporate the herbicide into the soil as well as to destroy any germinated weed seedlings.

Many herbicide combinations are registered for use on corn. The use of herbicide combinations that are not registered is discouraged since liability for performance and crop injury lie solely with the user. Similarly, the combination of herbicides with fertilizers or insecticides for simultaneous application is discouraged unless the herbicide label outlines directions for such combination use. Be sure to check the herbicide label or accompanying literature carefully before using herbicides in combination with fertilizers, insecticides, or other herbicides.

## Atrazine rate limits and restrictions

Because of concern about groundwater contamination, Wisconsin has enacted atrazine rate restrictions based on surface soil texture, prior atrazine use, and geographic location relative to atrazine detection in groundwater. Wisconsin's Atrazine Rule (ATCP 30) imposes a 0.75-1.5 lb/a rate limit on atrazine use statewide. An exception is allowed for growers who find it necessary to use atrazine postemergence to "rescue" seed or sweet corn from weed competition. This exception applies only to seed corn and sweet corn, and the total amount of atrazine used at

planting and postemergence may not exceed 1.5 lb/a on coarse soil and 2 lb/a on medium/fine soil. In addition, atrazine use is prohibited in extensive areas of Dane county and the entire Lower Wisconsin River valley extending downstream from the Highway 60 bridge at Prairie du Sac to the confluence of the Wisconsin and Mississippi Rivers. Localized areas of Adams, Brown, Calumet, Chippewa, Columbia, Dodge, Eau Claire, Grant, Green, Lake, Iowa, Jackson, Juneau, Lafayette, Manitowoc, Marathon, Marinette, Marquette, Monroe, Outagamie, Pierce, Portage, Richland, Rock, St. Croix, Sauk, Trempealeau, Vernon, Walworth, Waupaca, Waushara, Winnebago, and Wood counties have a total prohibition on atrazine use. Contact your county Extension office for detailed maps of atrazine prohibition areas or visit the DATCP website: [https://datcp.wi.gov/Pages/Programs\\_Services/Atrazine.aspx](https://datcp.wi.gov/Pages/Programs_Services/Atrazine.aspx)

Table 2-1 lists atrazine active ingredient rate limits for various management situations in Wisconsin, and table 2-2 lists the maximum rates of atrazine-containing products according to these rate limits. Be certain to reduce the use rates of atrazine and atrazine-containing products according to the Wisconsin Atrazine Rule.

State and federal rules have also established setbacks for mixing, loading, and applying atrazine and atrazine-containing herbicides. Heed the following guidelines to minimize ground- and surface water contamination by atrazine.

- No mixing or loading within 100 feet of wells, sinkholes, streams, lakes, or reservoirs unless mixing or loading over a spill containment pad constructed in compliance with Wisconsin ATCP 29. (Note: In Wisconsin, this rule applies for all pesticides. Federal rules require a 50-foot setback for atrazine only.)
- No application within 50 feet of a well or sinkhole or within 200 feet of the shoreline of natural or impounded lakes or reservoirs.
- No application within 66 feet of where field runoff enters streams (perennial or intermittent) and rivers.
- No application before April 1 or after July 31.
- Atrazine application records must be kept for 3 years.

## Burndown herbicides for no-till corn

No-till cropping systems are increasingly being used due to the economic and environmental benefits they offer. Weed management is particularly important in these systems because no tillage is done before planting and few producers cultivate no-till fields after planting. The purpose of a burndown herbicide application is to ensure that the crop is planted into a weed-free setting. Check fields carefully to determine if such a treatment is needed. Give particular attention to perennial weeds like dandelion, white cockle, and quackgrass plus winter annuals like horseweed (aka marestail), shep-

Table 2-1. Atrazine active ingredient rate limits

Surface soil texture	Statewide atrazine limits	
	Atrazine used last year	No atrazine used last year
Coarse	0.75 lb/a	0.75 lb/a
Medium/Fine	1.0 lb/a	1.5 lb/a

herd’s purse, chickweeds, buttercups, and pennycress.

### Terminating corn stands for replant

Occasionally corn stands are deemed undesirable due to low establishment rates and there is a need to terminate emerged corn seedlings with a herbicide in no-till situations. If the corn hybrid is not glyphosate-resistant (Roundup Ready), then glyphosate can be effectively used by following the burndown recommendations presented in the corn and soybean sections of this book. If the hybrid is glyphosate-resistant (Roundup Ready), then a supplemental label

exists for Select Max herbicide to be applied at 6 fl oz/a for corn up to 12 inches and the interval for replanting corn is reduced to 6 days. The replant interval is 30 days for higher rates. Follow adjuvant recommendations noted for Select Max in the **Postemergence herbicides** section of the soybean chapter of this book.

**Table 2-2.** Wisconsin rate limits for products containing atrazine<sup>a</sup>

Herbicide	Surface soil texture		
	Coarse	Medium/Fine	
	0.75 lb limit	1.0 lb limit	1.5 lb limit
Acuron	3 qt	4 qt	6 qt
Anthem ATZ	1.5 pt	2 pt	3 pt
atrazine 4L	1.5 pt	2.0 pt	3.0 pt
atrazine 90DF	0.83 lb	1.11 lb	1.67 lb
Bicep II Magnum	0.9 qt	1.3 qt	1.9 qt
Bicep Lite II Magnum	1.1 qt	1.5 qt	2.2 qt
Callisto Xtra	2.0 pt	2.5 pt	3.5 pt
Cinch ATZ	1.9 pt	2.5 pt	3.8 pt
Cinch ATZ Lite	2.2 pt	3.0 pt	4.5 pt
Degree Xtra	2.2 qt	2.98 qt	4.4 qt
FulTime NXT	2.2 qt	2.98 qt	4.4 qt
Harness Xtra	1.75 qt	2.35 qt	2.7 qt
Harness Xtra 5.6L	1.2 qt	1.6 qt	2.4 qt
Keystone LA NXT	1.75 qt	2.35 qt	2.7 qt
Keystone NXT	1.2 qt	1.6 qt	2.4 qt
Lexar EZ	1.7 qt	2.3 qt	3.4 qt
Stalwart 3W	1.8 qt	2.4 qt	3.5 qt

<sup>a</sup> Labeled rates of ImpactZ, and Lumax EZ do not exceed the atrazine rate limits.

**Table 2-3a.** Weed control ratings of corn herbicides applied preplant/preemergence<sup>a</sup>

	Site of action group	Risk of corn injury	Grasses							Broadleaves								Perennials					Caution statement <sup>b</sup>	
			Barnyardgrass	Crabgrass	Fall panicum	Field sandbur	Foxtails	Wild proso millet	Woolly cupgrass	Cocklebur	Common ragweed	Eastern black nightshade	Giant ragweed	Lambsquarters	Pigweeds	ALS & Gly-R Waterhemp	Smartweeds	Velvetleaf	Canada thistle	Dandelion	Hemp dogbane	Nutsedge		Quackgrass
Preplant ONLY																								
Fierce EZ	14, 15	2	9	9	9	6	9	7	7	5	7	8	5	9	9	8	7	7	5	5	5	7	—	x
Valor SX	14	2	5	5	5	5	6	5	5	5	7	8	5	9	9	8	7	7	5	6	5	0	0	x
Preplant or Preemergence																								
acetochlor <sup>c</sup>	15	1	9	9	9	7	9	7	7	5	7	8	5	8	9	8	7	5	0	0	0	7	0	x
acetochlor + atrazine <sup>c</sup>	5, 15	1	9	9	9	7	9	7	7	8	8	9	7	9	9	9	9	7	0	0	0	7	5	x
Acuron	5, 15, 27	1	9	9	9	8	9	7	7	8	9	9	8	9	9	9	9	9	5	7	5	7	5	x
Acuron Flexi	15, 27	1	9	9	9	8	9	7	7	8	9	9	7	9	9	9	9	9	5	7	5	7	5	
Anthem/Anthem Maxx	14, 15	1	9	9	9	6	9	7	7	5	6	8	5	8	8	8	5	7	0	0	0	7	0	
Anthem ATZ	5, 14, 15	1	9	9	9	7	9	7	7	7	8	9	7	9	9	9	9	8	5	5	5	7	5	x
Armezon PRO	15, 27	1	9	9	9	7	9	7	7	0	6	8	0	7	8	8	0	0	0	0	0	7	0	x
atrazine	5	0	7	5	5	7	7	5	5	8	8	9	7	9	9	8	9	7	5	5	5	5	6	x
Balance Flexx	27	1	7	7	7	7	7	7	8	6	9	9	6	9	9	9	9	9	0	7	—	5	5	x
Basis Blend	2	3	8	6	6	0	8	4	4	6	6	6	0	8	9	4	5	6	0	0	0	—	0	
Callisto/mesotrione 4L <sup>d</sup>	27	1	5	6	5	5	5	5	5	7	8	9	7	9	9	8	9	9	5	5	0	5	0	
Corvus	2, 27	1	9	9	9	6	9	9	8	6	9	9	7	9	9	9	9	9	—	7	—	6	0	x
Harness MAX	15, 27	1	9	9	9	8	9	8	7	7	8	9	7	9	9	9	9	9	5	5	0	7	0	x
Hornet WDG	2,4	2	0	0	0	0	0	0	0	8	9	8	7	8	8	4	8	8	5	5	5	0	0	
Instigate	2,27	2	8	7	7	5	8	7	7	8	8	9	7	9	9	8	9	9	6	7	5	6	6	
Lexar EZ/Lumax EZ/ Stalwart 3W	5, 15, 27	1	9	9	9	7	9	7	7	8	8	9	8	9	9	9	9	9	5	7	5	7	5	x
Maverick	4, 15, 27	1	9	9	9	7	9	7	7	9	9	9	8	9	9	9	9	9	5	7	5	7	5	x
metolachlor/ S-metolachlor <sup>c</sup>	15	1	9	9	9	7	9	7	7	5	5	8	5	7	8	8	5	5	0	0	0	7	0	
metolachlor/ S-metolachlor + atrazine <sup>c</sup>	5, 15	1	9	9	9	7	9	7	7	8	8	9	7	9	9	9	9	7	0	0	0	7	5	x
Outlook	15	1	9	9	9	7	9	7	7	5	5	8	5	7	8	8	5	5	0	0	0	7	0	x
Princep/simazine	5	0	7	7	6	5	7	5	5	7	8	9	7	9	9	8	9	8	5	5	5	5	5	
Python	2	2	0	0	0	0	0	0	0	7	7	7	5	8	8	4	8	8	0	5	5	0	0	
Resicore/Resicore XL	4, 15, 27	1	9	9	9	7	9	7	7	9	9	9	8	9	9	9	9	9	5	7	5	7	5	x

Continued on next page

 Principles of pest  
management

Corn weeds

Soybean

 Forages &  
pastures

Small grains

 Stored grain  
insects

Appendix

**Table 2-3a.** Weed control ratings of corn herbicides applied preplant/preemergence<sup>a</sup>

	Site of action group	Risk of corn injury	Grasses							Broadleaves								Perennials					Caution statement <sup>b</sup>	
			Barnyardgrass	Crabgrass	Fall panicum	Field sandbur	Foxtails	Wild proso millet	Woolly cupgrass	Cocklebur	Common ragweed	Eastern black nightshade	Giant ragweed	Lambsquarters	Pigweeds	ALS & Gly-R Waterhemp	Smartweeds	Velvetleaf	Canada thistle	Dandelion	Hemp dogbane	Nutsedge		Quackgrass
Resolve Q	2	2	8	6	7	5	8	5	5	5	6	5	5	8	8	4	7	7	5	0	5	5	5	x
Sharpen	14	2	5	5	5	5	5	5	5	7	9	8	8	8	8	8	7	7	5	6	5	0	0	x
Storen	15, 27	1	9	9	9	8	9	7	7	8	9	9	8	9	9	9	9	9	5	7	5	7	5	
SureStart II/Tripleflex II	2, 4, 15	1	8	8	8	6	8	7	6	7	7	8	6	9	9	9	8	8	5	8	5	6	0	x
Acuron Flexi	15, 27	1	9	9	9	8	9	7	7	8	9	9	8	9	9	9	9	9	5	7	5	7	5	
TriVolt	2, 15, 27	1	9	9	9	6	9	9	8	6	9	9	7	9	9	9	9	9	—	7	—	6	0	x
Verdict	14,15	2	7	7	7	5	7	6	6	7	9	8	8	8	8	8	8	7	5	6	5	5	0	
Zidua	15	1	9	9	9	7	9	7	7	5	6	8	5	8	8	8	5	6	0	0	0	7	0	
Preemergence ONLY																								
Prowl H2O	3	2	8	9	9	8	9	7	7	4	0	4	0	9	9	8	4	4	0	0	0	0	0	x

Control ratings: 10 = excellent; 8 = good; 6 = fair; 4 = poor; 0 = none; — = insufficient information

<sup>a</sup> These herbicides have been rated for expected weed control, but actual results may vary depending upon rates applied, soil types, weather conditions, and crop management.

<sup>b</sup> If column is marked with an x, see table 2-3b for caution statement.

<sup>c</sup> Acetochlor, metolachlor, S-metolachlor, and premixes of these with atrazine are available from a number of manufacturers – see corn herbicide descriptions for more information.

<sup>d</sup> Mesotrione is sold as a 4.0L formulation under numerous trade names including, Argos, Bellum, Callisto, Explorer, Incinerate, Motif, and Quartz.

**Table 2-3b.** Cautionary statements for corn herbicides applied before corn emergence<sup>a</sup>

Preemergence (PRE) herbicides	Caution statement
acetochlor	Do not apply within 50 ft of wells if soil is sandy with less than 3% organic matter, loamy sands with less than 2% organic matter, or sandy loams with less than 1% organic matter when depth to groundwater is less than 30 feet.
acetochlor + atrazine	Contains atrazine; please follow the restrictions in ATCP 30. Do not apply before April 1 or after July 31. Do not apply within 50 ft of wells if soil is sandy with less than 3% organic matter, loamy sands with less than 2% organic matter, or sandy loams with less than 1% organic matter when depth to groundwater is less than 30 feet.
Acuron	Contains atrazine; please follow the restrictions in ATCP 30. Do not apply before April 1 or after July 31.
Anthem ATZ	Contains atrazine; please follow the restrictions in ATCP 30. Do not apply before April 1 or after July 31.
Armezon PRO	Do not use on sands with less than 3% organic matter when depth to groundwater is less than 30 feet.
atrazine	Follow the atrazine restrictions in ATCP 30. Do not apply before April 1 or after July 31.
Balance Flexx	Labeled for use in Columbia, Dane, Dodge, Fond du Lac, Grant, Green, Jefferson, Lafayette, Rock, Sauk, Walworth, and Waukesha counties only. Cannot be used on soils classified as course-textured if depth to groundwater is less than 25 ft. See label for restrictions related to tile-outletted fields. Applications can only be applied between April 1 and July 31 of any year.
Corvus	Labeled for use in Columbia, Dane, Dodge, Fond du Lac, Grant, Green, Jefferson, Lafayette, Rock, Sauk, Walworth, and Waukesha counties only. Cannot be used on soils classified as course-textured if depth to groundwater is less than 25 ft. See label for restrictions related to tile-outletted fields. Applications can only be applied between April 1 and July 31 of any year.
Fierce EZ	Use only on no-till or minimum tillage fields where last year's crop residue has not been incorporated into the soil. Plant corn between 7 and 30 days after application.
Harness Max	Do not apply within 50 ft of wells if soil is sandy with less than 3% organic matter, loamy sands with less than 2% organic matter, or sandy loams with less than 1% organic matter when depth to groundwater is less than 30 feet.
Lexar EZ/Lumax EZ/ Stalwart 3W	Contains atrazine; please follow the restrictions in ATCP 30. Do not apply before April 1 or after July 31.
Maverick	Not recommended on soils with more than 10% organic matter.
metolachlor + atrazine	Contains atrazine; please follow the restrictions in ATCP 30. Do not apply before April 1 or after July 31.
Prowl H2O	Apply after planting before weeds germinate. Do not apply preplant. Plant corn at least 1.5 inches deep and completely cover with soil or injury may occur.
Outlook	Do not use on sands with less than 3% organic matter when depth to groundwater is less than 30 feet.
Resicore/Resicore XL	Not recommended on soils with more than 10% organic matter.
Resolve Q	Do not apply Resolve preemergence to coarse-textured soils with less than 1% organic matter.
Sharpen	Do not use on sands with less than 3% organic matter and where depth to groundwater is 30 feet or less.
SureStart II/Tripleflex II	Only labeled for use on field and silage corn. When depth to groundwater is less than 30 feet, do not use on sands with less than 3% organic matter, on loamy sands with less than 2% organic matter, or on sandy loams with less than 1% organic matter.
TriVolt	Labeled for use in Columbia, Dane, Dodge, Fond du Lac, Grant, Green, Jefferson, Lafayette, Rock, Sauk, Walworth, and Waukesha counties only. Cannot be used on soils classified as course-textured if depth to groundwater is less than 25 ft. See label for restrictions related to tile-outletted fields. Applications can only be applied between April 1 and July 31 of any year.
Valor SX	Use only on no-till or minimum tillage fields where last year's crop residue has not been incorporated into the soil. Corn must be planted between 7 and 30 days after application unless Valor SX was applied in the Fall. Planting interval is dependent on rate used.

**Table 2-3c. Weed control ratings of corn herbicides applied postemergence<sup>a</sup>**

Postemergence (POST) herbicides	Site of action group	Risk of corn injury	Grasses							Broadleaves							Perennials					Caution statement <sup>b</sup>		
			Barnyardgrass	Crabgrass	Fall panicum	Field sandbur	Foxtails	Wild proso millet	Woolly cupgrass	Cocklebur	Common ragweed	Eastern black nightshade	Giant ragweed	Lambsquarters	Pigweeds	ALS & Gly-R Waterhemp	Smartweeds	Velvetleaf	Canada thistle	Dandelion	Hemp dogbane		Nutsedge	Quackgrass
2,4-D	4	3	0	0	0	0	0	0	0	9	9	6	8	9	9	9	6	8	8	7	8	0	0	
acetochlor + atrazine <sup>c,d</sup>	5, 15	1	6	5	5	5	7	5	5	8	8	8	7	8	8	7	6	7	0	5	0	6	6	x
Accent Q	2	2	9	3	9	7	9	8	7	5	0	4	0	6	7	4	6	4	6	8	6	9	7	
Acuron	5, 15, 27	1	7	8	5	5	7	5	5	9	9	9	9	9	9	9	9	9	8	7	7	7	5	x
Acuron GT	9, 15, 27	1	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	8	8	8	8	9	x
Acuron Flexi	15, 27	1	6	8	5	5	6	5	5	8	8	9	8	9	9	9	9	9	6	7	6	7	5	
Anthem/ Anthem Maxx <sup>f</sup>	14,15	2	0	0	0	0	0	0	0	5	4	6	3	8	6	6	5	9	0	0	0	0	0	
Anthem ATZ	5, 14, 15	2	6	4	4	4	7	4	4	8	8	8	7	8	8	8	6	9	0	5	0	6	6	x
Armezon/ Armezon PRO <sup>f</sup>	27	1	7	7	6	4	6	7	6	8	7	9	7	9	9	8	8	9	7	7	—	0	0	x
atrazine	5	1	7	5	5	5	8	5	5	9	9	9	8	9	9	8	6	8	0	5	0	7	7	x
Balance Flexx <sup>d</sup>	27	2	6	6	6	6	6	6	6	6	8	8	6	8	8	8	8	8	0	6	—	6	5	x
Basagran	6	0	0	0	0	0	0	0	0	8	7	7	7	7	7	7	8	8	0	5	5	8	0	
Basis Blend <sup>d</sup>	2	3	8	7	7	4	8	6	6	7	7	0	4	8	9	4	9	8	6	7	5	—	7	
Brox 2EC	6	2	0	0	0	0	0	0	0	9	9	8	7	9	8	7	9	8	6	5	5	0	0	
Cadet	14	2	0	0	0	0	0	0	0	5	4	6	3	8	6	6	5	9	0	0	0	0	0	
Callisto	27	1	6	8	5	5	6	5	5	8	8	9	8	9	9	9	8	9	6	7	6	7	5	
Calisto Xtra	27,5	1	6	8	5	5	7	5	6	9	9	9	9	9	9	9	9	9	6	7	5	7	5	x
Capreno	2,27	1	8	8	8	8	8	8	7	9	9	9	8	9	9	9	9	9	7	5	5	0	0	
Corvus <sup>d</sup>	27,2	2	6	6	6	6	6	6	6	6	8	8	6	8	8	8	8	8	0	6	—	6	5	x
dicamba	4	2	0	0	0	0	0	0	0	9	8	8	9	9	9	9	9	8	8	8	8	0	0	
Diflexx	4	2	0	0	0	0	0	0	0	9	8	8	9	9	9	9	9	8	8	8	8	0	0	
Diflexx Duo	4,27	2	8	8	5	7	8	8	7	9	9	9	9	9	9	9	9	9	9	8	8	0	7	
Enlist Duo	4,9	1	9	9	9	9	9	9	9	9	9	9	8	9	9	9	8	8	9	7	8	7	8	x
Enlist One	4	1	0	0	0	0	0	0	0	9	9	7	8	9	9	9	6	8	8	7	8	0	0	x
glufosinate	10	1	7	8	8	7	8	8	8	9	9	9	8	8	8	8	9	8	7	8	7	5	7	x
glyphosate	9	1	9	9	9	9	9	9	9	9	9	9	8	9	9	4	8	8	8	7	8	7	8	x
Halex GT	15,9,27	1	9	9	9	9	9	9	9	9	9	9	8	9	9	9	9	9	8	8	8	7	9	x
Harmony SG	2	3	0	0	0	0	0	0	0	6	6	0	5	9	9	4	9	9	5	5	5	0	0	
Harness MAX	15, 27	1	6	8	5	5	6	5	5	8	8	9	8	9	9	9	9	9	6	7	6	7	5	x
Hornet WDG	2,4	2	0	0	0	0	0	0	0	9	8	7	8	7	7	6	8	9	8	8	5	0	0	

Continued on next page

 Principles of pest  
management

Corn weeds

Soybean

 Forages &  
pastures

Small grains

 Stored grain  
insects

Appendix

**Table 2-3c.** Weed control ratings of corn herbicides applied postemergence<sup>a</sup>

Postemergence (POST) herbicides	Site of action group	Risk of corn injury	Grasses							Broadleaves								Perennials					Caution statement <sup>b</sup>	
			Barnyardgrass	Crabgrass	Fall panicum	Field sandbur	Foxtails	Wild proso millet	Woolly cupgrass	Cocklebur	Common ragweed	Eastern black nightshade	Giant ragweed	Lambsquarters	Pigweeds	ALS & Gly-R Waterhemp	Smartweeds	Velvetleaf	Canada thistle	Dandelion	Hemp dogbane	Nutsedge		Quackgrass
Impact/ Impact Core <sup>f</sup>	27	1	7	7	6	4	6	7	6	8	7	9	7	9	9	8	8	9	7	7	—	0	0	
ImpactZ	27, 5	1	8	8	6	4	8	7	6	9	9	9	9	9	9	9	9	9	7	7	—	0	0	x
Instigate	2,27	2	7	6	7	6	7	6	6	8	8	9	8	9	9	8	9	9	6	7	5	6	6	
Laudis	27	1	8	8	5	7	8	8	7	9	9	9	8	9	9	9	9	9	7	5	5	0	7	
Lexar EZ/ Lumax EZ/ Stalwart 3W	15,5,27	1	6	8	5	5	7	5	6	9	9	9	9	9	9	9	9	9	6	7	5	7	5	x
Maverick	15,27,4	2	5	8	5	5	5	5	5	9	8	9	8	9	9	9	8	9	8	7	8	7	5	x
metolachlor/ S-metolachlor + atrazine <sup>c,d</sup>	5, 15	1	6	5	5	5	7	5	5	8	8	8	7	8	8	7	6	7	0	5	0	6	6	x
NorthStar	2,4	3	5	5	8	7	7	5	5	9	9	9	9	9	9	7	9	9	8	7	8	6	8	x
Permit/Sandea	2	1	0	0	0	0	0	0	0	9	9	0	7	5	8	4	8	9	5	5	0	9	0	
Python <sup>d</sup>	2	2	0	0	0	0	0	0	0	6	6	6	4	7	6	4	7	9	0	5	5	0	0	
Realm Q	2,27	2	7	5	7	6	7	6	6	8	8	9	8	9	9	8	9	9	6	7	5	7	6	x
Resicore/Resicore XL	15,27,4	2	5	8	5	5	5	5	5	9	8	9	8	9	9	9	8	9	8	7	8	7	5	x
Resolve Q	2	2	8	5	8	5	8	7	7	7	7	4	5	8	9	4	7	8	7	7	5	6	6	
Resources	14	2	0	0	0	0	0	0	0	6	7	4	4	7	8	5	4	9	5	0	0	0	0	
Revulin Q	2, 27	2	8	8	8	8	9	8	8	8	7	9	8	9	9	9	9	9	6	7	5	7	8	
Shieldex	27	1	6	7	5	-	8	6	5	7	8	7	8	9	9	8	7	9	6	-	-	-	-	
Sinate	10, 27	1	8	8	8	7	8	8	8	9	9	9	8	9	9	8	9	9	7	8	7	5	7	x
Status	4	2	6	6	6	4	6	5	4	9	8	8	8	9	9	9	9	8	8	9	8	0	0	x
Steadfast Q	2	3	9	5	8	8	9	8	8	6	5	5	5	6	8	4	7	6	6	8	5	5	8	
Stinger/Stinger HL	4	1	0	0	0	0	0	0	0	9	8	8	8	4	4	4	6	5	9	8	5	0	0	
Storen	15, 27	1	6	8	5	5	6	5	5	8	8	9	8	9	9	9	9	9	6	7	6	7	5	
SureStart II/Triple- Flex II <sup>d</sup>	15,4,2	1	0	0	0	0	0	0	0	8	7	7	7	5	5	4	5	8	7	7	5	0	0	x
TriVolt <sup>d</sup>	2, 15, 27	2	6	6	6	6	6	6	6	6	8	8	6	8	8	8	8	8	0	6	—	6	5	x
Yukon	2,4	2	0	0	0	0	0	0	0	9	9	7	8	8	9	9	8	8	5	7	6	9	0	

Control ratings: 10 = excellent; 8 = good; 6 = fair; 4 = poor; 0 = none; — = insufficient information

<sup>a</sup> These herbicides have been rated for expected weed control, but actual results may vary depending upon rates applied, soil types, weather conditions, and crop management.<sup>b</sup> If column is marked with an x, see table 2-3d for caution statement.<sup>c</sup> Acetochlor plus atrazine and metolachlor/S-metolachlor plus atrazine premixes available from several manufacturers — see corn herbicide descriptions for more information.<sup>d</sup> Will only provide limited burndown control when applied to very small weeds. Not recommended for use alone when applying to emerged weeds.<sup>e</sup> Mesotrione is sold as a 4.0L formulation under numerous trade names including, Argos, Bellum, Callisto, Explorer, Incinerate, Motif, and Quartz.<sup>f</sup> Anthem Maxx, Armezon PRO and Impact Core will provide residual control of certain small seeded broadleaves and most grass species if an activating rainfall occurs within 7 days after application.

**Table 2-3d.** Cautionary statements for corn herbicides applied after corn emergence<sup>a</sup>

<b>Postemergence (POST) herbicides</b>	<b>Caution statement</b>
acetochlor + atrazine	Contains atrazine; please follow the restrictions in ATCP 30. Do not apply before April 1 or after July 31.
Acuron	Contains atrazine; please follow the restrictions in ATCP 30. Do not apply before April 1 or after July 31.
Acuron GT	Use only on glyphosate tolerant hybrids.
Anthem ATZ	Contains atrazine; please follow the restrictions in ATCP 30. Do not apply before April 1 or after July 31.
Armezon PRO	Do not use on sands with less than 3% organic matter when depth to groundwater is less than 30 feet.
atrazine	Follow the atrazine restrictions in ATCP 30. Do not apply before April 1 or after July 31.
Balance Flexx	Labeled for use in Columbia, Dane, Dodge, Fond du Lac, Grant, Green, Jefferson, Lafayette, Rock, Sauk, Walworth, and Waukesha counties only. Cannot be used on soils classified as course-textured if depth to groundwater is less than 25 ft. See label for restrictions related to tile-outletted fields. Applications can only be applied between April 1 and July 31 of any year.
Callisto Xtra	Contains atrazine; please follow the restrictions in ATCP 30. Do not apply before April 1 or after July 31.
Corvus	Labeled for use in Columbia, Dane, Dodge, Fond du Lac, Grant, Green, Jefferson, Lafayette, Rock, Sauk, Walworth, and Waukesha counties only. Cannot be used on soils classified as course-textured if depth to groundwater is less than 25 ft. See label for restrictions related to tile-outletted fields. Applications can only be applied between April 1 and July 31 of any year.
Enlist Duo	Use only on Enlist corn hybrids.
Enlist One	Use only on Enlist corn hybrids.
glufosinate	Use only on glufosinate tolerant hybrids.
glyphosate	Use only on glyphosate tolerant hybrids.
Halex GT	Use only on glyphosate tolerant hybrids.
Harness Max	Do not apply within 50 ft of wells if soil is sandy with less than 3% organic matter, loamy sands with less than 2% organic matter, or sandy loams with less than 1% organic matter when depth to groundwater is less than 30 feet.
ImpactZ	Contains atrazine; please follow the restrictions in ATCP 30. Do not apply before April 1 or after July 31.
Lexar EZ/Lumax EZ/Stalwart 3W	Contains atrazine; please follow the restrictions in ATCP 30. Do not apply before April 1 or after July 31.
Maverick	Not recommended on soils with more than 10% organic matter.
metolachlor + atrazine	Contains atrazine; please follow the restrictions in ATCP 30. Do not apply before April 1 or after July 31.
NorthStar	Do not use on sweet corn.
Realm Q	Do not apply to field corn grown for seed, popcorn, or sweet corn.
Resicore/Resicore XL	Do not apply POST to popcorn. Not recommended on soils with more than 10% organic matter.
Sinate	Use only on glufosinate tolerant hybrids.
Status	Do not use on soils classified as sand with less than 3% organic matter and where groundwater depth is shallow.
SureStart II/Tripleflex II	Only labeled for use on field and silage corn. When depth to groundwater is less than 30 feet, do not use on sands with less than 3% organic matter, on loamy sands with less than 2% organic matter, or on sandy loams with less than 1% organic matter.
TriVolt	Labeled for use in Columbia, Dane, Dodge, Fond du Lac, Grant, Green, Jefferson, Lafayette, Rock, Sauk, Walworth, and Waukesha counties only. Cannot be used on soils classified as course-textured if depth to groundwater is less than 25 ft. See label for restrictions related to tile-outletted fields. Applications can only be applied between April 1 and July 31 of any year.

## Corn herbicides

### 2,4-D Amine, 2,4-D LV ester, 2,4-D acid 2,4-D (4)

\*There are many brands and formulations of 2,4-D available for use. Application rates, adjuvant recommendations, and other guidelines for use vary among 2,4-D products. Consult product labels for more specific product use guidelines and restrictions.

**Preplant/PRE Rate:** 0.5-1 lb acid equivalent/a. For 3.8 lb ae/gal formulations (LV4/Amine4) – 1-2.1 pt/a. For 5.6 lb ae/gal formulations (LV6/Amine6) – 0.7-1.43 pt/a. Use higher rates for large difficult to control weeds, or if under less favorable growth conditions.

**POST Rate:** 0.25-0.5 lb ae/a. For 3.8 lb ae/gal formulations (LV4/Amine4) – 0.5-1 pt/a. For 5.6 lb ae/gal formulations (LV6/Amine6) – 0.36-0.7 pt/a. Use higher rates for large or perennial broadleaf weeds.

**Adjuvants:** For preplant or preemergence applications, COC at 1% v/v OR NIS at 0.25% v/v may be added to improve control of large or difficult to control weeds. For applications made to emerged corn, DO NOT add COC or serious corn injury may occur. Add surfactant if directed by tank-mix partner.

**Crop stage:** Apply preplant following appropriate preplant intervals, a minimum of 7 days following 0.5 lb ae/a and a minimum of 14 days after 1 lb ae/a. Apply after corn planting but prior to emergence. Apply early postemergence to 4-8 inch tall corn. Can be applied to corn <4" but should avoid spraying as the first leaves are unfolding as injury may occur. Use drop nozzles for late postemergence applications to corn between 8 inches tall until 1 week before tassel emergence. Preharvest applications can be made after silks brown.

**Weed Timing:** Will only control emerged broadleaf weeds. Annual broadleaf weeds are controlled best when less than 3 inches tall. Perennial broadleaves should be in the bud stage for the best control.

**Remarks:** Postemergence application of 2,4-D may be used on field corn, silage corn, and sweet corn. Because sweet corn is more susceptible to damage than field corn, 2,4-D is seldom used on sweet corn. If used on sweet corn use the lower rate in the rate range. Corn hybrids vary in their tolerance to 2,4-D. Corn injury is most likely when corn is growing rapidly under high temperature and high soil moisture conditions. Under such circumstances, delay cultivation for 8-10 days to allow corn to overcome any temporary stalk brittleness. For early postemergence applications, use the lower rate for treatment in hot, humid weather. For late drop-nozzle applications, adjust the application rate in direct

proportion to the amount of the field area actually being treated. If the entire row and inter-row area is being treated, no rate reduction is necessary. Direct the spray toward the base of the corn row to obtain maximum weed coverage with minimum corn injury. Smartweeds and wild buckwheat are somewhat tolerant of 2,4-D, especially the amine form. Use precautions to prevent drift. The ester forms of 2,4-D can volatilize and injury nearby susceptible plants. Amine and acid formulations are less volatile than ester formulations and are preferable for POST applications in corn. The purpose of preharvest treatment is to limit weed seed production and suppress tall growing weeds that might interfere with corn harvest. Apply 1 qt/a by ground or air after corn silks turn brown. Some studies have shown substantial reduction in the viability of certain weed seeds, but velvetleaf seed viability was reduced only slightly.

### Aatrex/atrazine atrazine (5)

\*There are many brands of atrazine available for use. Most atrazine products are formulated as either a liquid containing 4 lb ai/gal or a dry granular containing 90% ai. See individual product labels for specific product use guidelines and restrictions.

**Rate:** *atrazine 4L:* 1.5-3.0 pt/a; *atrazine 90DF:* 0.83-1.67 lb/a. Rate will be dependent on soil type and previous year's atrazine use; do not exceed the maximum allowable atrazine active ingredient rate limits listed in Table 2-1.

**Adjuvants:** Add COC at 1% v/v if applying POST to emerged weeds. Oil-based adjuvants speed weed burndown but can also burn leaf margins and occasionally stunt corn. Injury is increased by cold, wet weather or any other conditions that put corn under stress.

**Crop stage:** Apply up to 45 days prior to planting (PP/PPI) on medium and fine textured soil; on coarse textured soil do not apply more than 14 days prior to planting. For best results with PPI applications, apply within 14 days of planting and avoid deep incorporation. Apply during or shortly after planting (PRE) up to 12 inch corn (POST).

**Weed timing:** Provides residual and burndown control of many annual broadleaf and grass weeds. Because of the 0.75-1.5 lb ai/a rate limit, soil-applied atrazine treatments are generally inadequate for complete weed control. Apply before grasses exceed 1.5 inches and broadleaves exceed 4 inches for best results with POST applications. Will not control triazine resistant weeds. Atrazine should be tank-mixed with other corn herbicides to broaden the spectrum of control and/or increase the length of residual.

**Remarks:** Many cases of atrazine- (triazine-) resistant common lambsquarters, smooth pigweed,

velvetleaf, and kochia have been documented in Wisconsin. Increasing the atrazine rate or altering application timing will not control triazine-resistant weeds. Atrazine is ineffective on peat or muck soils. Atrazine can be mixed with liquid fertilizer for simultaneous PP/PPI or PRE applications. Wisconsin ATCP 30 allows POST rescue treatments to seed and sweet corn only of up to 1.5 lb ai/a (coarse soils) or 2 lb ai/a (medium/fine soils). This rescue treatment cannot be used in atrazine prohibition areas.

### Accent Q nicosulfuron (2) + safener

**Rate:** 0.45-1.8 oz/a; 0.9 oz/a will provide optimum control of labeled grass weeds. Increase rate up to 1.8 oz/a for partial control of weeds exceeding labeled height by up to 50%.

**Adjuvants:** Add COC at 1% v/v or NIS at 0.25% v/v. Also add 2 qt/a of 28% UAN or 2 lb/a of spray-grade AMS. COC is the preferred adjuvant for most tank mixtures except products containing dicamba, where a NIS is preferred.

**Crop stage:** Apply from emergence through the 6-collar (V6) stage but before corn is 20 inches tall. Use drop nozzles for 20- to 36-inch-tall corn. Do not apply to corn taller than 36 inches or V10, whichever comes first. Do not apply Accent Q to seed corn or popcorn that is more than 20 inches tall or V6.

**Weed timing:** Apply to young actively growing grass weeds. Weeds that exceed listed weed sizes may be partially controlled with Accent Q. Lacks residual control, but if a second flush of weeds develops, a second application may be made.

**Remarks:** Can be tank mixed with atrazine, butrill, mesotrione, dicamba, topramezone plus atrazine, NorthStar, or Status to provide broadleaf control. Do not tank mix with POST herbicides like Basagran or 2,4-D because crop injury or antagonism may occur. Tank mixing with dicamba may increase the risk of rat-tailing if applied to small corn. Do not use on fields treated with Counter 20G applied in furrow at planting or over the row at cultivation. May injure corn treated with Counter 20G, Lorsban, or Thimet if soil has less than 4% organic matter. May be used on field corn, silage corn, seed corn, popcorn, and on sweet corn hybrids except for Merit, Carnival, and Sweet Success.

### acetochlor + atrazine premix

acetochlor (15) + atrazine (5) + safener

### acetochlor + atrazine 6.0L

Products: Harness XTRA, Keystone LA NXT, Fearless Xtra, Volley ATZ NXT, Confidence Xtra, Tremor ATZ Lite NXT, Breakfree NXT Lite, Cadence LA NXT, Overtime ATZ Lite NXT.

**Rate:** 1.8-2.3 qt/a. coarse-1.8 qt/a; medi-

um-1.8-2.3 qt/a; fine-2-2.3 qt/a. In areas with heavy weed infestation, up to 2.7 qt/a can be applied on medium and fine textured soils. May be applied at 1.2 qt/a in a planned sequential 2-pass herbicide program.

#### acetochlor + atrazine 5.6L

**Products:** Harness XTRA 5.6L, Keystone NXT, Fearless Xtra 5.6L, Volley ATZ NXT, Confidence Xtra 5.6L, Tremor ATZ NXT, Cadence ATZ NXT, Overtime ATZ NXT.

**Rate:** 1.4-2.4 qt/a. *Less than 3% organic matter:* coarse-1.2 qt/a; medium-1.7-2.4 qt/a; fine-2.3-2.4 qt/a. *3% or more organic matter:* coarse-1.2 qt/a; medium/fine-2.3-2.4 qt/a.

#### Degree Xtra/FulTime NXT 4.0L

**Rate:** 2.9-3.7 qt/a. coarse-2.2 qt/a; medium-2.9-3.7 qt/a; fine-3.2-3.7 qt/a. In areas with heavy weed infestation, up to 4.3 qt/a can be applied on medium and fine textured soils. May be applied at 2 qt/a in a planned sequential 2-pass herbicide program.

**Adjuvants:** Include adjuvants according to requirements of the tank-mix partner if applying to emerged weeds.

**Crop stage:** Apply up to 45 days prior to planting (PP). Split applications can be made 30-45 days before planting with 60% of the rate applied initially and the remaining 40% applied at planting. PPI applications should be made within 14 days of planting and incorporated into the upper 1-2 inches of soil. Apply during or shortly after planting (PRE) up to 11 inch corn (POST).

**Weed timing:** Will provide residual control of labeled grass and broadleaf weeds. Provides good to excellent control of foxtails, crabgrass, fall panicum, and most annual broadleaf weeds but will have little effect on quackgrass. Some velvetleaf and giant ragweed may escape. Preplant surface-applied acetochlor + atrazine can be applied up to 30 days before planting, but it gives the best control when applied closer to planting and before weeds emerge. If weeds are present at the time of treatment, include glyphosate, Gramoxone, or 2,4-D in the spray mixture for annual weed burndown. Can be tank mixed with Princep and many other corn PRE herbicides to enhance broadleaf weed control. Will also provide burndown activity on small annual broadleaf weeds but generally will not control emerged annual grasses unless they have only one or two leaves. Larger emerged weeds need to be controlled by a tank-mix partner, like glyphosate or glufosinate, on resistant hybrids.

**Remarks:** Degree XTRA and FulTime NXT are an encapsulated formulation of acetochlor plus

atrazine. The acetochlor + atrazine 6.0L and Degree XTRA/FulTime NXT formulated products closely match atrazine rate limits with the proper amount of acetochlor for good grass control. The 5.6L formulations contain a higher concentration of atrazine than the 6.0L formulations. To stay below Wisconsin's atrazine rate limits, the rates of 5.6L formulations that can be used may not provide the desired amount of acetochlor. Do not exceed the atrazine limits based on soil type and past atrazine use specified in Table 2-2. Can be mixed with liquid fertilizer or impregnated onto certain dry fertilizers for simultaneous application. May cause temporary corn leaf burn when applied POST. May be used on field corn, seed corn, and sweet corn.

**Acuron** S-metolachlor (15) + atrazine (5) + mesotrione (27) + bicyclopyrone (27)

**Rate:** 2.5-3.0 qt/a; 2.5 qt/a is recommended for soils with less than 3% organic matter, otherwise use 3.0 qt/a. May be applied as a split application. Apply 1/2 to 2/3 of the labeled rate PRE, followed by 1/2 to 1/3 of the labeled rate POST. PRE rates as low as 2 qt/a can be used when followed with a POST application of glyphosate or glufosinate. Rates of 1.5-2 qt/a can be used in POST tank-mixtures with glyphosate or glufosinate.

**Adjuvants:** Add NIS at 0.25% v/v when applying to emerged corn if weeds are present. AMS at 8.5-17 lb/100 gal may also be used. Do not include NIS in tank mixtures with loaded glyphosate formulations or Liberty herbicide. Do not use COC, MSO or liquid nitrogen if corn has emerged.

**Crop stage:** Apply up to 28 days prior to planting (PP/PRE). Apply POST up to 12 inch tall corn. Do not apply POST to sweet corn or yellow popcorn.

**Weed timing:** Provides residual control/suppression of many broadleaf and grass species. Also provides control of small (less than 3 inches), emerged broadleaf weeds. Will not provide consistent control of most emerged grass weeds. Control of emerged grasses will require the addition of another herbicide with grass activity.

**Remarks:** Do not exceed 3 qt/a of Acuron herbicide per year. If any products containing atrazine or S-metolachlor have been applied prior to Acuron, limit applications to conform with label and state atrazine restrictions. Not recommended for soils with 10% or more organic matter. Applying Acuron POST to corn that received an at-plant application of Counter insecticide can result in severe crop injury.

**Acuron GT** S-metolachlor (15) + glyphosate (9) + mesotrione (27) + bicyclopyrone (27)

**Rate:** 3.75 pt/a

**Adjuvants:** Add NIS at 0.25-0.5% v/v and AMS

at 8.5-17 lb/100 gal. When using liquid AMS, use a rate that delivers an equivalent rate. Do not use MSO or liquid nitrogen unless directed for a specific tank-mix.

**Crop stage:** Apply to glyphosate-resistant corn from emergence up to 30 inches tall or no later than the 8-leaf (V8) growth stage.

**Weed timing:** Apply before grass and broadleaf weeds exceed 4 inches tall for best results. Will provide 3-4 weeks of residual control of susceptible weeds if an activating rainfall is received within 7-10 days after application. Can be tank mixed with other herbicides, such as atrazine or dicamba, to improve control of glyphosate resistant broadleaf weeds or weeds greater than 4 inches.

**Remarks:** Acuron GT is specifically formulated for postemergence use in glyphosate-resistant field corn. Does not contain the safener benoxacor and is not recommended for preplant or preemergence applications. Do not make more than a single application of Acuron GT at 3.75 pt/a in a single year. Severe corn injury may occur if Acuron GT is tank-mixed with emulsifiable concentrate products.

**Acuron Flexi** S-metolachlor (15) + mesotrione (27) + bicyclopyrone (27)

**Rate:** 2-2.25 qt/a; 2 qt/a is recommended for soils with less than 3% organic matter, otherwise use 2.25 qt/a. May be applied as a split application. Apply 1/2 to 2/3 of the labeled rate PRE, followed by 1/2 to 1/3 of the labeled rate POST. PRE rates as low as 1.35 on soils with <3% OM and 1.5 qt/a on soils with >3% OM can be used when followed with a POST application of glyphosate or glufosinate. Rates of 1.25-2.25 qt/a can be used in POST tank-mixtures with glyphosate or glufosinate.

**Adjuvants:** Add NIS at 0.25% v/v if weeds are present. Add AMS at 8.5-17 lb/100 gal if application occurs prior to corn emergence. COC may result in crop injury and if used do not exceed 1 qt/a. Do not include NIS in tank mixtures with loaded glyphosate formulations or Liberty herbicide. Do not use MSO or nitrogen based additives (UAN, AMS) if corn has emerged unless directed by label for a specific tank, i.e. glyphosate.

**Crop stage:** Apply up to 28 days prior to planting (PP/PRE). Apply POST up to V8 or 30 inch tall corn, whichever occurs first. Do not apply POST to sweet corn or yellow popcorn.

**Weed timing:** Provides residual control/suppression of many broadleaf and grass species. Also provides control of small (less than 3 inches), emerged broadleaf weeds. Will not provide consistent control of most emerged grass weeds. Control of emerged grasses will require the addition of another herbicide with grass activity. See label for the range of tank mix partners.

**Remarks:** This product was developed for atrazine prohibition areas. Applying Acuron Flexi POST to corn that received an at-plant application of Counter insecticide can result in severe crop injury. Applying an OP insecticide or Counter within 7 days before or after may result in severe corn injury. Not recommended for soils with 10% or more organic matter. Can tank mix with glyphosate. If formulation is fully loaded, AMS may be added at 8.5 lb/100 gal. If glyphosate formulation requires an adjuvant plus AMS, add 0.25% v/v NIS plus AMS.

**Anthem Maxx** pyroxasulfone (15)  
+ fluthiacet-methyl (14)

**PP/PPI/PRE Rate:** 2.5-6.5 fl oz/a; Rate is dependent upon the soil type and percent organic matter (see label). For early preplant applications made 15-45 days before planting and/or in reduced tillage systems or heavy weed pressure use the higher labeled rates by soil type.

**POST Rate:** 2-6 fl oz/a. coarse textured soil, <1% OM – 2-3 fl oz; coarse textured, >1% OM, 2-3.5 fl oz; medium textured – 2.5-4.5 fl oz; fine textured – 3.5-6 fl oz.

**Adjuvants:** Add either COC or MSO at 1-2 pt/a or NIS at 0.25% if weeds are emerged at application. UAN at 1-2 qts/a or AMS at 8.5-17 lb/100 gal may also be added.

**Crop stage:** Apply from up to 45 days preplant through the V4 corn growth stage. For PPI applications incorporate into the upper 1-2" of soil up to 14 days before planting.

**Weed Timing:** Anthem Maxx provides residual control of many grass and broadleaf species. Anthem Maxx will also control or suppress certain emerged broadleaf weeds. Applications to weeds larger than specified on the label can result in unsatisfactory control. Will not control emerged grasses. Can be tank mixed with atrazine, mesotrione, or isoxaflutole to improve residual control of broadleaves (lambquarters, velvetleaf, giant ragweed, common ragweed).

**Remarks:** Contains twice as much active ingredients as Anthem (apply at 1/2 the rate of Anthem). Anthem Maxx can be applied in sequential programs but do exceed the maximum use rate per year; 4.5 fl oz/a, coarse texture, 8.15 fl oz/a medium and fine texture. Separate sequential applications by at least 14 days. May be tank mixed with many fluid fertilizers, impregnated on many dry fertilizers, and mixed with many insecticides and fungicides.

**Anthem ATZ** atrazine (5) +  
pyroxasulfone (15) + fluthiacet-methyl (14)

**PP/PPI PRE Rate:** 1.75-3.0 pt/a; Rate is dependent upon the soil type and percent organic matter

(see label). For early preplant applications made 15-45 days before planting and/or in reduced tillage systems or heavy weed pressure use the higher labeled rates by soil type.

**POST Rate:** 1.5-3 pt/a; coarse textured soil – 1.5-2 pt/a; medium textured – 1.75-2.25 pt/a; fine textured – 2-3 pt/a.

**Adjuvants:** Add either COC or MSO at 1-2 pt/a or NIS at 0.25% if weeds are emerged at application. UAN at 1-2 qts/a or AMS at 8.5-17 lb/100 gal may also be added.

**Crop stage:** Can be applied up to 45 days prior to planting through emergence.

**Remarks:** Uniform spray coverage is needed for optimum performance. May be tank mixed with other products (see label for specific mixing details).

**Weed timing:** Anthem ATZ provides residual control of many grass and broadleaf species. For POST applications, apply when weeds are 4 inches or less in height except for velvetleaf (see label). Applications to weeds larger than specified on the label can result in unsatisfactory control. Will not control emerged grasses. Can be tank mixed with mesotrione or isoxaflutole to improve residual control of broadleaves.

**Remarks:** Do not exceed the atrazine limits based on soil type and past atrazine use specified in Table 2-2. Anthem ATZ can be applied in sequential programs but do exceed the maximum use rate per year. May be tank mixed with many fluid fertilizers, impregnated on many dry fertilizers, and mixed with many insecticides and fungicides.

**Armezon** topramezone (27)

**POST:** 0.5-1.0 fl oz/a; Use 0.5 fl oz/a if rotating to snap beans.

**Adjuvants:** Add 1.0-1.5% methylated seed oil (preferred) or crop oil concentrate. Also add 1.25-2.5% of 28% nitrogen solution or 8.5-17 lb/100 gal of ammonium sulfate.

**Crop stage:** Apply from emergence until 45 days before corn harvest or V-8 corn, whichever comes first.

**Remarks:** A preemergence grass herbicide application or postemergence grass herbicide tank mix may be advised for total grass weed control. Topramazone works synergistically with atrazine, so tank mixtures with 0.25-1.0 lb/a atrazine are recommended. It can also be tank mixed with most other postemergence herbicides, including glyphosate and Liberty 280 SL, on resistant hybrids. Corn has good tolerance to topramazone, but under stressful conditions, NIS should be used in tank mixtures with 2,4-D or dicamba to reduce the risk of injury. Topramazone has no insecticide use restrictions. Drift will bleach the leaves of sensitive plants. Do not apply if wind speed exceeds 10 mph.

Topramazone is rainfast in 1 hour. Topramazone can be used on field corn (grain, silage, and seed) and sweet corn.

**Armezon PRO** topramezone (27) +  
dimethenamid-P (15)

**Rate:** 14-24 fl oz/a. Rate structure is dependent on both soil texture class and organic matter content. See label for details.

**Adjuvants:** Armezon PRO applied alone: Use MSO, COC or HSOC at 0.5-1% v/v. Use higher rate during periods of hot dry weather. All tank mixtures: NIS at 0.25-0.5% v/v can be substituted to reduce the potential for increased corn leaf necrosis. Oil-type adjuvants (MSO, COC, HSOC) are not recommended when tank mixing with atrazine. A nitrogen fertilizer should also be included. Add UAN at 1.25-2.5% v/v or AMS at 8.5-17 lbs/100 gal.

**Crop stage:** PRE to V8 or 30-inch tall corn, whichever occurs first. For applications when corn is greater than 12 but before 30 inches tall, drop nozzles should be used.

**Weed timing:** Provides residual control of certain small seeded broadleaf and grass species. The topramezone component of Armezon PRO also provides control of certain emerged broadleaf and grass weeds. For best results apply to weeds that are 4-inches or less and actively growing.

**Remarks:** Armezon PRO may be tank mixed or applied sequentially with other corn herbicides to provide both broader spectrum and residual weed control. Tank mixes with atrazine are known to enhance the activity of HPPD-inhibitor (group 27) herbicides like Armezon PRO. Up to two applications of Armezon PRO can be made during a growing season. Sequential applications must be separated by at least two weeks and must not exceed more than a cumulative amount of 28 fl oz/a.

**Autumn Super 51 WDG** iodosulfuron (2)  
+ thien carbazon (2)

**Burndown rate:** 0.5 oz/a

**Adjuvants:** COC, N, AMS, MSO; Add 1% crop oil concentrate or methylated seed oil and either 1.5-2 qt/a 28% urea ammonium nitrate or 1.5-3.0 lb/a ammonium sulfate.

**Crop stage:** Apply in the fall after harvest or 30 days before planting corn in the spring.

**Weed timing:** The label recommends application to certain broadleaf weeds up to 3 inches and annual grasses no greater than 1 inch in height.

**Remarks:** Intended to provide fall burndown control and limited residual activity on broadleaf weeds including alfalfa, plantain, dandelion, horseweed, and several mustard species. It can be tank mixed with 2,4-D, glyphosate, dicamba, paraquat,

or metribuzin for enhanced burndown activity and increased weed spectrum and sizes consistent with the label of the tank-mix partner. The 30-day interval between application and corn planting will primarily limit use to fall applications. It is rainfast in 2 hours.

---

### Balance Flexx isoxaflutole (27) + safener

Labeled for use in Columbia, Dane, Dodge, Jefferson, Fond du Lac, Grant, Green, Lafayette, Rock, Sauk, Waukesha, and Walworth counties.

**Rate:** 3-6 fl oz/a; Rate is dependent on application timing, soil texture and % organic matter, see label for details. Cannot be used on soils classified as course-textured if depth to groundwater is less than 25 feet.

**Adjuvants:** Add COC or MSO at 1% v/v when applying to emerged weeds and prior to corn emergence. DO NOT use adjuvants when applying to emerged corn. NIS can be substituted for COC/MSO when mixing with liquid nitrogen fertilizer or certain glyphosate formulations.

**Crop stage:** Apply prior to corn emergence up to 21 days before planting (PP/PPI/PRE). May be applied up to 30 days prior to planting when used in a planned sequential program. For PPI applications, do not incorporate deeper than 2 inches. Apply early POST from corn spiking through V2 corn.

**Weed timing:** Provides effective residual control of many broadleaf and grass weeds. The addition of an atrazine containing product will improve weed control consistency. Will provide preplant burndown control of labeled weeds 3 inches or less in height when used with an appropriate adjuvant. For larger weeds include an appropriate tank mix partner. Balance may not provide control of emerged weeds larger than the 1 true leaf stage in early POST applications.

**Remarks:** Do not use COC, MSO, or a loaded glyphosate formulation with Balance Flexx applied to emerged corn. Tank-mixtures with herbicides other than atrazine or Diflexx are not recommended for early POST applications as crop response symptoms including bleaching, leave edge necrosis and stunting may result. See label for restrictions related to tile-outletted fields.

---

### Basagran bentazon (6)

**Rate:** 1.5-2.0 pt/a

**Adjuvants:** COC, N, AMS; For common lambsquarters and/or common ragweed, add 1 qt/a of crop oil concentrate in the spray mixture. If velvetleaf is the primary weed problem, add 2-4 qt/a of 28% nitrogen solution or 2.5 lb/a of spray grade ammonium sulfate in the spray mixture. If all are present, use crop oil concentrate plus a nitrogen additive.

**Crop stage:** Applications are generally made to 1- to 5-leaf corn, but all stages are tolerant.

**Remarks:** May be tank mixed with atrazine, Clarity, glyphosate (Roundup Ready only), and Liberty 280 SL (Liberty Link only). Corn is quite tolerant, but slight, temporary leaf speckling may occur. May be used on field corn, silage corn, seed corn, and sweet corn.

---

### Basis Blend rimsulfuron (2) + thifensulfuron (2)

**Burndown/PRE Rate:** 0.825-2.5 oz/a; 1.25-1.5 oz/a is recommended for most preplant/preemergence applications.

**POST Rate:** 0.825 oz/a

**Adjuvants:** Add COC or MSO at 1% v/v or NIS at 0.25% v/v PLUS either 28-32% UAN at 2 qt/a or AMS at 2 lb/a. COC plus ammonium nitrogen fertilizer is the preferred adjuvant system. When tank mixed with loaded glyphosate or glufosinate products COC/MSO/NIS is not required.

**Crop stage:** Apply in the fall through early spring, up to planting whenever the ground is not frozen (PP/PRE). Apply within 7 days before planting or PRE after planting for greatest residual control. Apply POST from spike through the V2 corn growth stage.

**Weed timing:** Basis Blend provides preplant weed burndown and limited early season residual control of labeled grass and broadleaf weeds. It will control foxtails up to 2 inches tall; woolly cupgrass up to 1 inch tall; and lambsquarters, pigweed, smartweeds, and velvetleaf up to 3 inches tall. At 1.25 oz/a or more, quackgrass, and common ragweed should be controlled. Basis Blend should control small dandelions. Basis Blend can be tank mixed with a variety of herbicides to improve both burndown and residual control, see label for potential tank mixes.

**Remarks:** Basis Blend is not labeled for use on coarse-textured soils with less than 1% organic matter. Do not tank mix with Basagran. Injury from Basis Blend has occasionally occurred, especially if applied after the 2-collar stage. Tank mixing Basis Blend with dicamba may increase the risk of rattailing if applied POST. Do not apply to hybrids with relative maturities of less than 88 days, or they may be injured. Applying to corn treated with Counter 20G, Lorsban, or Thimet may cause injury. Applying after Aztec, Force, or Fortress should not cause injury.

---

### Bicep Lite II Magnum

S-metolachlor + atrazine (5) + safener

**Rate:** 0.9-2.2 qt/a. Rate is dependent on application timing, soil texture, and % organic matter, see label for details.

**Adjuvants:** Include adjuvants according to requirements of the tank-mix partner if applying to emerged weeds.

**Crop stage:** For coarse textured soils, apply within 14 days of planting. For medium/fine textured soils, apply up to 45 days preplant. Applications made more than 30 days before planting should be part of a split application with 2/3 of the rate applied initially and the remaining 1/3 at planting. For PPI applications, incorporate into the top 2 inches of soil within 14 days before planting. Can be applied POST up to 5-inch corn or as a directed application to 12-inch corn.

**Weed timing:** Provides good to excellent residual control of foxtails, crabgrass, fall panicum, and most annual broadleaf weeds. Some velvetleaf and giant ragweed may escape. Can be tank mixed with many corn PRE herbicides to enhance broadleaf weed control. The atrazine component will also provide burndown activity on small annual broadleaf weeds but generally will not control emerged annual grasses unless they have only one or two leaves. Larger emerged weeds need to be controlled by a tank-mix partner, like glyphosate or glufosinate, on resistant hybrids.

**Remarks:** This premix contains the correct ratio of atrazine to s-metolachlor to maintain the full rate of s-metolachlor with the maximum allowable rate of atrazine for Wisconsin. Bicep Lite II Magnum is ineffective in peat or muck soils. This formulation contains a chemical safener to protect corn and injury is unlikely. It can be mixed with liquid fertilizer for simultaneous preplant-incorporated or preemergence applications and can also be impregnated onto certain dry fertilizers. Bicep Lite II Magnum may be used on field corn, silage corn, and sweet corn.

---

### Brox 2EC bromoxynil (6)

**Rate:** 1.0-1.5 pt/a; Apply 1 pt/a after emergence or 1.5 pt/a after the 4-leaf stage but before tassel emergence. Rates can be increased to 2 pt/a under stressful conditions and where atrazine cannot be used.

**Adjuvants:** Do not use adjuvants with Brox unless required for a tank mixture.

**Crop stage:** Apply from the 4-leaf stage to before tassel.

**Weed timing:** When corn is so large that it interferes with the spray pattern, use drop nozzles to direct the herbicide beneath the corn leaves and onto the weeds.

**Remarks:** To broaden the spectrum of weed control, the labeled rate of Brox can be tank mixed with 2,4-D or dicamba. However, this tank mixture introduces risk of 2,4-D or dicamba injury. Use application precautions when applying 2,4-D or

dicamba. Brox can also be tank mixed with atrazine, Accent Q, Permit, or Stinger. Brox usually causes temporary leaf burn, but injury may be excessive if applied before the 4-leaf stage. Brox tank mixtures that require a surfactant may increase leaf burn. Brox is a contact herbicide, so good spray coverage is important. Brox may be used on field and popcorn.

---

**Cadet** fluthiacet-methyl (14)

**Rate:** 0.4-0.9 fl oz/a; Apply 0.4 to 0.6 fl oz/a in glyphosate mixtures or 0.6-0.9 fl oz/a if applied alone or in other tank mixtures.

**Adjuvants:** NIS, COC, N, AMS; Add nonionic surfactant at 0.25% or crop oil concentrate at 1-2 pt/a to the spray solution; 28% nitrogen solution at 1-2 qt/a or ammonium sulfate at 1-2 lb/a may also be added. If mixed with a fully loaded glyphosate, only add ammonium sulfate as required for glyphosate.

**Crop stage:** Apply from V2 until 48 inches tall or tasseling, whichever occurs first.

---

**Callisto** mesotrione (27)

\*Mesotrione is sold as a 4.0L formulation under numerous trade names including, Argos, Bellum, Callisto, Explorer, Incinerate, Motif, and Quartz. Rate structure and product use guidelines are very similar to Callisto; however, consult individual product labels prior to use.

**Preplant/PRE Rate:** 6-7.7 fl oz/a; Apply 6.0-7.7 fl oz/a when applied alone or 5.3-6 fl oz/a when tank mixed with an atrazine-containing herbicide.

**POST Rate:** 3 fl oz/a

**Adjuvants:** Add COC at 1% v/v or NIS at 0.25% v/v PLUS either 28-32% UAN at 2.5% v/v or AMS at 8.5 lb/100 gal if applying POST to emerged weeds. COC is the preferred adjuvant system. Do not use MSO for POST applications as severe crop injury may occur unless directed for a specific tank mix on the label.

**Crop stage:** Apply preplant or preemergence. Apply POST up to the V8 growth stage or 30 inch corn, whichever occurs first. If atrazine is mixed with mesotrione, do not apply to corn taller than 12 inches.

**Weed timing:** Provides residual and burndown control of many annual broadleaf weeds, but will not control most grasses. Control of giant ragweed is improved in mixtures with atrazine. Does not control grasses and should be tank mixed with an acetamide grass herbicide (Dual II Magnum, Harness, Outlook, etc), or an acetamide/atrazine premix (Bicep Lite II Magnum, Harness Xtra, etc.) Mesotrione can be tank mixed with many POST corn herbicides, including glyphosate and glufosinate on resistant hybrids. Consult label for specific tank mix recommendations and use guidelines.

**Remarks:** Do not exceed more than 2 applications

or a total of 7.7 fl oz/a per year. Do not make the second application within 14 days of the first. Corn has good tolerance to PRE and POST applications, but occasional yellowing may be seen after POST applications under stressful conditions. Do not tank mix with grass herbicides that have an emulsifiable concentrate formulation and apply after corn has spiked because injury may occur. Do not apply if the corn was treated with Counter 20G because injury may occur. Corn may also be injured if Lorsban was applied. Do not tank mix mesotrione with organophosphate or carbamate insecticides or apply these insecticides within 7 days of Callisto because injury may occur. Mesotrione can be applied with water or liquid fertilizer (except suspension fertilizers) as the carrier. Mesotrione can be applied to field, silage, seed, and sweet corn.

---

**Callisto Xtra** mesotrione (27) + atrazine (5)

**Rate:** 20-24 fl oz/a; Increasing the rate to 24 fl oz/a will improve residual activity.

**Adjuvants:** Add COC at 1% v/v plus either UAN at 2.5% v/v or AMS at 8.7-17 lb/100 gal. Do not use nitrogen fertilizers when treating sweet corn. NIS may be substituted for COC but weed control may be reduced. MSO should not be used due to increased crop injury.

**Crop stage:** Apply after emergence but before corn exceeds 12 inches in height.

**Weed timing:** Controls many annual broadleaf weeds but will require a tank-mix partner for grass control. Can be tank mixed with many POST corn herbicides to improve burndown and residual control, including glyphosate and glufosinate on resistant hybrids. Consult label for specific tank mix recommendations and use guidelines.

**Remarks:** Corn has good tolerance, but bleaching can be observed under certain environmental conditions; the injury is typically transitory and does not affect yields. Do not tank mix with emulsifiable grass herbicides unless specifically addressed in the label or crop injury could occur. Do not apply in liquid fertilizer or to corn treated with Counter 20G or Lorsban or severe crop injury could occur. Do not apply in a tank mix with organophosphate or carbamate insecticides or apply postemergence within 7 days before or after an organophosphate or carbamate insecticide application as crop injury could occur.

---

**Capreno** thiencazabone (2) + tembotrione (27) + safener

**Preplant/PRE Rate:** 3-6 fl oz/a

**POST Rate:** 3 fl oz/a

**Adjuvants:** Add COC at 1% v/v PLUS either UAN at 1.25 qt/a or AMS at 1.5 lb/a. A high surfactant oil

concentrate (HSOC) at recommended rates may be substituted for COC. MSO at 0.5% v/v may be substituted for COC under adverse conditions (drought stress, low humidity, etc.)

**Crop stage:** Apply preplant or preemergence. Apply POST from the V1-V6 growth stage or 20 inch corn, whichever occurs first. If atrazine is mixed with Capreno, do not apply to corn taller than 12 inches.

**Weed timing:** Provides residual control of some broadleaf and several grass weeds but will not provide acceptable season-long residual control. Should be tank mixed with an additional residual PRE herbicide or be followed by a planned POST application. Capreno also provides good POST control of many emerged broadleaf and grass weeds. Apply before broadleaf weeds exceed 6 inches and grass weeds exceed 3 inches and are not tillering. Capreno can be mixed at 3 fl oz/a with glyphosate and glufosinate on resistant hybrids. Check the herbicide label for specific adjuvant recommendations for glufosinate or glyphosate mixtures. The Laudis component of Capreno is synergized by 0.5 lb/a atrazine and improves the consistency of control.

**Remarks:** Do not apply on coarse textured soils with less than 2% organic matter. If applied PRE, Capreno cannot be applied POST. Consult the label for insecticide interaction information and restrictions before making an application of Capreno.

---

**Clarity** dicamba (4)

**Rate:** 0.5-1.0 pt/a; 0.5 pt/a is the maximum rate for late postemergence treatments.

**Adjuvants:** N, AMS; Adding 2 to 4 qt/a of 28% nitrogen solution or 2.5 lb/a ammonium sulfate to the spray mixture will improve control of wild mustard and velvetleaf that are over 5 inches tall or growing under drought stress.

**Crop stage:** Apply early postemergence treatments from emergence through the 5-leaf stage but before the corn is 8 inches tall. Apply late postemergence treatments when corn is 8-36 inches tall and at least 15 days before tasseling.

**Weed timing:** Annual broadleaf weeds are controlled best when they are less than 3 inches tall. Treat perennials when they are 10-18 inches tall.

**Remarks:** Can be tank mixed with most postemergence herbicides as early post-emergence treatments. To lessen the chance of injury, use the 0.5 pt/a rate on loamy sands and sandy loams. Do not use on sand with less than 3% organic matter where ground water depth is shallow. Corn injury from dicamba is only slightly less likely than with 2,4-D. Some stalk brittleness and lodging may occur. Do not cultivate for at least 7 days after treatment or until injury symptoms disappear. Soybean, tobacco, and most vegetable are extremely sensitive

to dicamba, so avoid drift. Do not apply when soybeans are nearby if corn is taller than 24 inches, soybean is taller than 10 inches, or the soybean has begun to blossom.

**Corvus** isoxaflutole (27) + thienencarbazone (2)

**Labeled for use in Columbia, Dane, Dodge, Jefferson, Fond du Lac, Grant, Green, Lafayette, Rock, Sauk, Waukesha, and Walworth counties.**

**Rate:** 3.33-5.6 fl oz/a; Rate is dependent on soil texture and % organic matter, see label for details. Cannot be used on soils classified as course-textured if depth to groundwater is less than 25 feet.

**Adjuvants:** Add COC or MSO at 1% v/v when applying to emerged weeds and prior to corn emergence. DO NOT use adjuvants when applying to emerged corn. NIS can be substituted for COC/MSO when mixing with liquid nitrogen fertilizer or certain glyphosate formulations.

**Crop stage:** Apply prior to corn emergence up to 21 days before planting (PP/PPI/PRE). May be applied up to 30 days prior to planting when used in a planned sequential program. For PPI applications, do not incorporate deeper than 2 inches. Apply early POST from corn spiking through V2 corn.

**Weed timing:** Provides effective residual control of many broadleaf and grass weeds. The addition of an atrazine containing product will improve weed control consistency. Will provide preplant burndown control of labeled weeds 6 inches or less in height when used with an appropriate adjuvant. For larger weeds include an appropriate tank mix partner. Corvus may not provide control of emerged weeds larger than the 1 true leaf stage in early POST applications.

**Remarks:** Do not use COC, MSO, or a loaded glyphosate formulation with Corvus applied to emerged corn. Tank-mixtures with herbicides other than atrazine or DiFlexx are not recommended for early POST applications as crop response symptoms including bleaching, leave edge necrosis and stunting may result. See label for restrictions related to tile-outletted fields.

**Degree XTRA** acetochlor (15) + atrazine (5)  
+ safener

**See information under Acetochlor + Atrazine premix.**

**DiFlexx** dicamba (4) + safener

**Burndown/PRE Rate:** 8-16 fl oz/a. Use the higher rates in the rate range on soils high in organic matter or under heavy infestations with weeds greater than 6-inches or known herbicide resistance.

**POST Rate:** 6-16 fl oz/a. Use the higher rates under

heavy infestations with weeds greater than 6-inches or known herbicide resistance.

**Adjuvants:** Add NIS at 0.25% v/v or COC or MSO at 1% v/v plus either UAN at 2-4 qt/a or AMS at 8.5-17 lb/100 gal.

**Crop stage:** Up to 14 days before, during or after planting but before crop emergence and from spike through the V10 growth stage or 36-inch tall corn, whichever occurs first.

**Weed timing:** Will control emerged labeled broadleaf weeds and provide limited residual control of labeled weeds. Best results occur when weeds are less than 3-inches tall.

**Remarks:** Up to two applications of DiFlexx can be made during a growing season. Sequential applications must be separated by at least two weeks and must not exceed more than a cumulative amount of 24 fl oz/a. Has reduced injury potential compared to dicamba products without the safener. Do not apply when soybeans are nearby if corn is taller than 24-inches, soybean is taller than 10-inches, or the soybean has begun to bloom.

**DiFlexx Duo** dicamba (4) + tembotrione (27)

+ safener

**Burndown/PRE Rate:** 32-40 fl oz/a. Use the higher rates in the rate range under heavy infestations with weeds greater than 6-inches or known herbicide resistance.

**POST Rate:** 24-40 fl oz/a. Use the higher rates under heavy infestations with weeds greater than 6-inches or known herbicide resistance.

**Adjuvants:** COC, MSO, HSOC, UAN, AMS. Add COC or MSO at 1% v/v plus either UAN at 1.5 qt/a or AMS at 8.5-17 lb/100 gal. Use UAN under conditions of low relative humidity for improved weed control.

**Crop stage:** Preplant/PRE and from spike through the V6 growth stage or 36-inch tall corn, whichever occurs first. Can be applied with drop nozzles to corn from V7 to V10, up to 36" tall or 15 days prior to tassel, whichever occurs first.

**Weed timing:** Will control emerged labeled broadleaf and grass weeds. Best results occur when weeds are less than 6-inches tall. DiFlexx Duo also provides early season residual control/suppression of certain grass and broadleaf weeds but will generally not provide season-long residual weed control. Can be tank-mixed with other corn products, like atrazine, glufosinate, and glyphosate, to provide broader spectrum weed control.

**Remarks:** Up to two applications of DiFlexx can be made during a growing season. Sequential applications must be separated by at least two weeks and must not exceed more than a cumulative amount of 78 fl oz/a. Always follow the directions of the most restrictive label. Has reduced injury potential com-

pared to dicamba products without the safener. Do not apply when soybeans are nearby if corn is taller than 24-inches, soybean is taller than 10-inches, or the soybean has begun to bloom.

**Dual II Magnum** S-metolachlor (15)  
+ safener

**Rate:** 1-2 pt/a; Rate dependent on % soil organic matter and texture, see label for details. On soils with an organic matter content between 6 and 20%, use up to 2.5 pt/a if applying before corn emergence.

**Crop stage:** Apply up to 45 days preplant until corn reaches 40 inches in height. Drop nozzles are recommended for applications to corn taller than 5 inches. Applications made more than 30 days before planting should be part of a split application with 2/3 of the rate applied initially and the remaining 1/3 at planting. For PPI applications, incorporate into the top 2 inches of soil within 14 days before planting. Can also be applied in the fall after September 30 for spring weed control.

**Weed timing:** Provides residual control of annual grasses and small-seeded broadleaf weeds. Will not control emerged weeds. Dual II Magnum can be tank-mixed with many other corn herbicides to broaden the spectrum of control and to increase the length of residual control.

**Remarks:** Can be used on field corn, silage corn, and sweet corn. Dual II Magnum contains a chemical safener to protect corn; however, treated corn sprouting in cold, wet soil may occasionally leaf out underground. Can be mixed with liquid fertilizer for simultaneous application and preplant-incorporated Dual II Magnum can also be impregnated onto certain dry fertilizers. In dry seasons, preplant-incorporated applications will provide better annual weed control than preemergence applications.

**Elevore** halauxifen-methyl (4)

**Rate:** 1 fl oz/A.

**Adjuvants:** MSO or COC. Use a Crop Oil Concentrate (COC) or Methylated Seed Oil (MSO) at 4 to 8 pints per 100 gallons (0.5 – 1.0% v/v). All adjuvants and tank-mix partners must be approved on [Elevore-TankMix.com](#)

**Crop Stage:** At least 14 days prior to planting.

**Remarks:** Use Elevore herbicide for pre-plant burndown control of annual broadleaf weeds at least 14 days prior to planting. Elevore rapidly stops growth of established susceptible weeds. However, typical symptoms (discoloration) of dying weeds may not be noticeable for 1 or 2 weeks after application, depending upon growing conditions and weed susceptibility.

## Enlist Duo

glyphosate (9) + 2,4-D Choline (4)

PRE/ Burndown rate: 3.5-4.75 pt/a.

Adjuvants: See label or look up allowed adjuvants at [www.EnlistTankMix.com](http://www.EnlistTankMix.com)

Crop stage: Apply 7-14 days before planting corn or 3-5 days after planting but before corn emerges. For ENLIST corn apply anytime before or after planting.

Remarks: Provides control of common annual and perennial weeds. Do not use on sandy soils with less than 1% organic matter. List of products that can be tank mixed with Enlist Duo can be found at [www.EnlistTankMix.com](http://www.EnlistTankMix.com). Apply in water at 10 to 15 gallons per acre of spray solution.

POST: **FOR ENLIST Corn varieties only:** 3.5-4.75 pt/a.

**Adjuvants:** Include adjuvants according to requirements of the tank-mix partner. Only use water as a carrier when applying Dual II Magnum post-emergence; liquid fertilizer is not permitted as a carrier because of the risk of crop injury.

**Crop stage:** Can be applied to V8 corn or 30 inches tall, whichever comes first. If corn is 30-48 inches tall use drop nozzles.

Remarks: Make 1-2 applications at least 12 day apart. High rates may cause temporary spotting or plant leaning. List of products that can be tank mixed with Enlist Duo can be found at [www.EnlistTankMix.com](http://www.EnlistTankMix.com). Apply in water at 10 to 15 gallons per acre of spray solution. Do not apply more than one preemergence application and no more than two postemergence applications per season. Total amount of Enlist Duo applied in a season can't be more than 14.25 pints/a.

## Enlist One

2,4-D Choline (4)

PRE/ Burndown rate: 1.5-2.0 pt/a.

Adjuvants: See label or look up allowed adjuvants at [www.EnlistTankMix.com](http://www.EnlistTankMix.com)

Crop stage: Apply anytime before planting or after planting but before corn emerges.

Remarks: Provides control of common annual and perennial weeds. For best results do not use on sandy soils with less than 1% organic matter. Apply in water at 10 to 15 gallons per acre of spray solution.

POST: **FOR ENLIST Corn varieties only:** 2.0 pt/a.

**Crop stage:** Can be applied to V8 corn or 30 inches tall, whichever comes first. If corn is 30-48 inches tall use drop nozzles.

Remarks: Make 1-2 applications at least 12 day apart. High rates may cause temporary spotting or plant leaning. Apply in water at 10 to 15 gallons per acre of spray solution. Do not apply more than one preemergence application and no more than two postemergence applications per season. Total amount of Enlist One applied in a season can't be more than 6 pints/a.

## Fierce EZ

flumioxazin (14) + pyroxasulfone (15)

**Rate:** 6 fl oz/a. Can use 6-9 fl oz/a if applied in the fall.

**Adjuvants:** Fierce EZ does not require any spray additives; however, spray adjuvants should be used according to the label of the tank-mix partner.

**Crop stage:** Fierce EZ may be applied in the fall or in the spring as an early preplant burndown 7-30 days ahead of planting field corn in no-till and minimum till systems. If rates higher than 6 fl oz/a are used, or if herbicide is incorporated with tillage, then a minimum of 30 days is required before planting. If Fierce EZ is applied in the fall or winter following crop harvest, do not apply before October 15<sup>th</sup> and do not apply to frozen or snow-covered ground.

**Remarks:** Fierce EZ provides selective burndown and residual weed control in minimum and no-till field corn systems. Do not use on popcorn, sweet corn, or seed corn. Is primarily to be used in minimum till and no-till field corn systems. Fields can be cultivated following applications, but the minimum preplant interval is 30 days if the herbicide is incorporated, and incorporation will reduce residual weed control. Can be tank mixed with several other herbicides, including glyphosate and 2,4-D, to enhance burndown activity. Do not use on soils with less than 1% organic matter unless at least 1/2 inch of rainfall occurs before planting.

## FulTime NXT

acetochlor (15) + atrazine (5) + safener

See information under Acetochlor + Atrazine premix.

## glufosinate

glufosinate (10)

\*There are several brands of glufosinate (Liberty, Cheetah, Interline) available for use. Application rates, adjuvant recommendations, rainfast intervals, and other guidelines for use may vary among glufosinate products. Consult product labels for more specific product use guidelines and restrictions.

**Rate:** 0.53-0.79 lb ai/a; 29-43 fl oz/a of 2.34 lb/gal formulation. A minimum of 32 fl oz/a is recommended in the Liberty label.

**Adjuvants:** AMS at 1.5-3 lbs/a. Higher rates are recommended under unfavorable growing conditions. An anti-foam agent is recommended.

**Crop stage:** Can be applied as part of a preplant burndown program prior to planting of any corn hybrid. Can be applied postemergence in glufosinate tolerant corn hybrids from emergence through the V6 growth stage

**Weed timing:** Apply to small (<3 inches) and

actively growing weeds. Glufosinate is only foliar active and does not provide any residual control. Can be tank mixed with atrazine or most other post-emergence herbicides to enhance weed control or provide residual activity.

**Remarks:** For best results, make applications in warm temperatures, high humidity, and bright sunlight. Use nozzles that deliver medium-sized droplets for adequate spray coverage with a minimum of 15 gal/a spray solution. Increase rate to between 20 and 40 gal/a for dense canopy, large weeds, or unfavorable growing conditions. Sequential POST applications can be made in glufosinate tolerant corn hybrids but do not exceed 0.79 lb ai/a per year (87 fl oz/a). The second application should be made a minimum of 10 days after the first.

## glyphosate

glyphosate (9)

\*There are many brands of glyphosate available for use. Application rates, adjuvant recommendations, rainfast intervals, and other guidelines for use vary among glyphosate products. Consult product labels for more specific product use guidelines and restrictions.

**Burndown Rate:** 0.56-1.5 lb acid equivalent/a (lb ae/a).

**POST Rate:** glyphosate resistant corn only - 0.56-1.12 lb ae/a. The general recommendation on most labels is 0.75 lb ae/a (22 fl oz/a Roundup PowerMax). Rate should be increased to 1.12 lb ae/a (32 fl oz Roundup PowerMax) for perennials, larger weeds or in fields with a history of poor glyphosate performance.

**Adjuvants:** AMS at 8.5-17 lb/100 gal is typically recommended. Adjuvant recommendations vary among different glyphosate products. Consult specific product labels to see if the glyphosate formulation requires additional surfactant.

**Crop stage:** Any corn - preplant burndown. *Glyphosate resistant corn only* - Apply from emergence to V8 or 30 inch corn, whichever occurs first. Roundup Ready 2 corn hybrids can be sprayed with drop nozzles from 30-48 inches tall. Nozzles should be adjusted to keep spray out of corn whorls.

**Weed timing:** Glyphosate is a non-selective herbicide that controls most emerged annual and perennial grass and broadleaf weeds. *Annuals* - Best results are achieved when applied to weeds less than 4-8 inches tall. Annual weeds emerging after glyphosate application must be controlled by a residual herbicide or a postemergence herbicide. Glyphosate resistance has developed in populations of waterhemp, giant ragweed, and marestail in Wisconsin. Consider the use of an effective PRE herbicide and apply glyphosate at 1.5 lb ae/a when plants are small. *Perennials* - Best control

of perennials will occur at higher labeled rates when applied at the bud-bloom weed stage (or boot to seedhead for grasses). Minimum size of various perennial weeds for most effective control: quackgrass, Canada thistle, and yellow nutsedge – 6 inches; field bindweed and common milkweed – 12 inches; johnsongrass and hemp dogbane – 18 inches. To control quackgrass, apply 0.75 lb ae/a of glyphosate to 6-10-inch quackgrass if the field will be tilled after application. Delay tillage for 3 days after application. Increase the rate of glyphosate to 1.5 lb ae/a if the field will be no-till planted.

**Remarks:** Apply POST only on glyphosate resistant corn hybrids. Maximum POST rate per application is 1.12 lb ae/a and the total amount that can be applied POST in one season should not exceed 2.25 lb ae/a. There may be exceptions to this depending on the glyphosate product and type of glyphosate resistant corn planted. Consult seed supplier and glyphosate product label prior to use.

### Gramoxone SL 3.0 paraquat (22)

**Rate:** 1.3-2.7 pt/a. Apply 1.3-2.0 pt/a when weeds are 1-3 inches tall and 2.0-2.7 pt/a when weeds are 3-6 inches tall.

**Adjuvants:** Add NIS at 0.25% v/v. An appropriate COC or MSO adjuvant can be used at 1% v/v in place of NIS; however, NIS is the preferred adjuvant system when tank-mixed with other herbicides.

**Crop stage:** Apply preplant or before corn has emerged.

**Weed timing:** Will only control emerged weeds. Can include with preplant residual herbicides to provide residual control. Where a preplant treatment is made as a split application, include Gramoxone with the first application, but only if weed growth is present at the time of treatment. Annual weeds emerging after application must be controlled by the residual herbicide. Tank mixing with atrazine or Princep can increase burndown activity.

**Remarks:** Use a minimum of 10 gal/a of water at 30-50 psi pressure with ground applications. Flat fan nozzles are more effective than flood nozzles at delivering the fine spray droplets necessary for thorough spray coverage. If applying less than 20 gal/a of water, only use flat fan nozzles.

### Halex GT S-metolachlor (15) + glyphosate (9) + mesotrione (27)

**Rate:** 3.6-4 pt/a

**Adjuvants:** NIS, AMS; Add nonionic surfactant at 0.25-0.5% and ammonium sulfate at 8.5-17 lb/100 gal. Use of 28% nitrogen solution is not recommended because of the risk of injury.

**Crop stage:** Apply from emergence to 30 inches tall or the 8-collar (V8) stage.

**Weed timing:** Apply before grass and broadleaf weeds exceed 4 inches tall. Apply before weeds exceed 10 inches when tank mixed with atrazine.

**Remarks:** This premix contains about a half rate of Dual and a full rate of Callisto, which will provide residual weed control if rain is received after application. Halex GT will provide postemergence control of most annual weeds. The timing may be too early for optimal long-term control of perennials although existing shoots will be killed. The glyphosate rate in this premix will control weeds at the 4-inch stage. The Callisto component provides a second ingredient with postemergence broadleaf activity, which would improve control of glyphosate-resistant weeds. Halex GT can be applied following many preemergence herbicides. Lumex at 2 qt/a is the maximum rate that may be used prior to Halex GT applications because they also contain mesotrione. Halex GT can be tank mixed with atrazine for improved weed control, and 0.25-0.5 lb/a are recommended. Drift from Halex GT can injure adjacent crops or vegetation. Thoroughly clean the spray tank after use because residues can injure glyphosate- or Callisto-sensitive crops. Do not tank mix with emulsifiable concentrate grass herbicides because injury may occur. Halex GT may injure corn if the corn was treated with Counter 20G, Lorsban, or other organophosphate soil insecticides or applied within 7 days of a foliar organophosphate insecticide.

### Harmony SG thifensulfuron (2)

**Rate:** 0.125 oz/a

**Adjuvants:** NIS, COC, N, AMS; Add nonionic surfactant at 0.25% or crop oil concentrate at 1% plus either 2-4 qt/a 28% nitrogen solution or 2-4 lb/a of ammonium sulfate. With glyphosate tank mixtures, only ammonium sulfate is needed if the glyphosate is fully loaded with surfactant.

**Crop stage:** Apply to 1- to 5-collar (V1 to V5) stages, but before 16 inches tall.

**Remarks:** Tank mixing with atrazine or glyphosate (Roundup Ready only) will increase the weed spectrum beyond weeds listed. Thifensulfuron has minimal soil activity. Corn has good tolerance to thifensulfuron, but stressed plants may be injured. Do not apply to corn that is less than 88 days of maturity. Applications to corn treated with Counter 20G, Lorsban, or Thimet may cause crop injury. Apply to only field or silage corn.

### Harness acetochlor (15) + safener

**Rate:** 1.25-2.75 pt/a; Rate dependent on % soil organic matter and texture, see label for details. In no-till or reduced till systems use rates of coarse-1.5-2

pt/a; medium-2.25-2.75 pt/a; fine-2.75-3 pt/a. May be applied at 1.5 pt/a in a planned sequential 2-pass herbicide program. On soils with 6-10% organic matter, use 2.5-3.4 pt/a. Apply 3.4 pt/a on soils with greater than 10% organic matter.

**Adjuvants:** Add adjuvants according to requirements of the tank-mix partner.

**Crop stage:** Apply up to 45 days prior to planting (PP). Split applications can be made 30-45 days before planting with 60% of the rate applied initially and the remaining 40% applied at planting. PPI applications should be made within 14 days of planting and incorporated into the upper 1-2 inches of soil. Apply during or shortly after planting (PRE) up to 11 inch corn (POST).

**Weed timing:** Provides residual control of annual grasses and small-seeded broadleaf weeds. Will not control emerged weeds. Harness can be tank-mixed with many other corn herbicides to broaden the spectrum of control and to increase the length of residual. Check label for common PRE and POST tank mix recommendations.

**Remarks:** Harness treated corn sprouting in cold, wet soils may occasionally leaf out underground. Harness can be mixed with liquid fertilizer or impregnated onto certain dry fertilizers for simultaneous application. It may be used on field corn, seed corn, and sweet corn.

### Harness MAX acetochlor (15) + mesotrione (27)

**Preplant/PRE Rate:** 55-88 fl oz/a. Rates vary by soil type; coarse-55-64 fl oz; medium-64-75 fl oz; fine with <3% OM-64-75 fl oz; fine with >3% OM 75-88 fl oz. May use up to 95 fl oz/a on medium and fine textured soil in areas of heavy weed infestation. On soils with 6-10% OM use 81-95 fl oz/a. Can be applied at a rate as low as 1.8 qt/a as part of a 2-pass weed control system.

**POST Rate:** 40-75 fl oz/a. Rates vary by soil type; coarse-40-55 fl oz; medium-55-64 fl oz; fine with <3% OM-55-64 fl oz; fine with >3% OM 64-75 fl oz. May use up to 75 fl oz/a on medium and fine textured soil in areas of heavy weed infestation. On soils with >6% OM use 75 fl oz/a.

**Adjuvants:** Apply NIS at 0.25% v:v or COC at 1% v:v. UAN or AMS may be added but increase the risk of corn injury. Do not use MSO. Do not add COC, MSO, or UAN when tank mixing with glyphosate or glufosinate.

**Crop stage:** Apply from up to 30 days prior to planting (PP/PPI/PRE) through 11-inch corn (POST). PPI applications should be made within 14 days of planting and incorporated into the upper 1 inch of soil.

**Weed timing:** Provides early season residual control/suppression of many broadleaf and grass

species. The addition of atrazine will improve residual control of large-seeded broadleaves such as giant ragweed. The mesotrione component of Harness MAX also provides control of small (less than 3 inches), emerged broadleaf weeds. Can be used to improve burndown activity in preplant applications to emerged weeds. Will not provide consistent control of most emerged grass weeds. Tank mix with glyphosate or glufosinate to control emerged weeds and provide in-season residual control after application.

**Remarks:** Harness MAX may cause temporary bleaching, chlorotic/necrotic speckling when corn is stressed. Do not apply more than 95 fl oz/a per year and if applied PRE/PPI only 40 fl oz/a can be applied POST. It may be used on field corn, seed corn, and yellow popcorn.

### Harness XTRA/Harness XTRA 5.6L

acetochlor (15) + atrazine (5) + safener

See information under Acetochlor + Atrazine premix.

### Hornet WDG flumetsulam (2) + clopyralid (4)

**PPI/PRE Rate:** 4-5 oz/a. Rate dependent on % soil organic matter and texture, see label for details. Use higher end of use rate range on soils with >3% organic matter and/or when applications are made 14-30 days before planting.

**POST Rate:** 2-4 oz/a. Up to 5 oz/a can be used when applied to corn at the "spike" stage, from emergence up to 2-inch corn but before the first leaf unfurls. Use higher end of use rate range for control of heavy weed infestations, larger weeds, or when longer residual control is desired.

**Adjuvants:** NIS at 0.25% v/v or COC or MSO at 1% v/v. COC is the preferred adjuvant for Canada thistle control. Under dry growing conditions the use of a liquid nitrogen or ammonium sulfate may enhance control. Use UAN at 2.5% v/v or 2-4 lb/a of spray grade AMS.

**Crop stage:** Apply from 30 days prior to planting through the V6 growth stage or 20" tall corn, whichever occurs first. For PPI applications, incorporate into the top 2-3 inches of soil. Directed postemergence applications can be made with drop nozzles to corn that is 20-36 inches tall or has more than 6 leaf collars (V6). For corn grown for silage application must occur before corn reaches 20 inches or V6 growth stage.

**Weed timing:** Provides residual and burndown control of many annual broadleaf weeds. For control of emerged weeds apply to actively growing weeds within the labeled height range. Apply to 4-8 inch Canada thistle for best results. Because it is a broadleaf herbicide, Hornet WDG will generally

need to be tank mixed with grass herbicides for complete control.

**Remarks:** In dry seasons, preplant-incorporated applications will provide better annual weed control than preemergence applications. The flumetsulam component in this premix may cause corn stunting. The injury may be due to corn emerging in cold soils or to other factors. To minimize the risk of injury, plant corn at least 1.5 inches deep and use on soils with at least 1.5% organic matter. Hornet WDG is not recommended if Counter 20G or Thimet have been applied. Apply other soil insecticides in a T-band to avoid crop injury. Can be applied with liquid fertilizer or impregnated onto certain dry fertilizers for simultaneous applications, but the water soluble packages need to be slurried before mixing or impregnation. May be used on field corn but not sweet corn or popcorn.

### Impact

topramezone (27)

**Rate:** 0.5-2.0 fl oz/a; Use 0.5 fl oz/a if rotating to snap beans.

**Adjuvants:** Add 1.0-1.5% methylated seed oil (preferred) or crop oil concentrate. Also add 1.25-2.5% of 28% nitrogen solution or 8.5-17 lb/100 gal of ammonium sulfate.

**Crop stage:** Apply from emergence until 45 days before corn harvest or V-8 corn, whichever comes first.

**Remarks:** A preemergence grass herbicide application or postemergence grass herbicide tank mix may be advised for total grass weed control. Topramazone works synergistically with atrazine, so tank mixtures with 0.25-1.0 lb/a atrazine are recommended. It can also be tank mixed with most other postemergence herbicides, including glyphosate and Liberty 280 SL, on resistant hybrids. Corn has good tolerance to topramazone, but under stressful conditions, NIS should be used in tank mixtures with 2,4-D or dicamba to reduce the risk of injury. Topramazone has no insecticide use restrictions. Drift will bleach the leaves of sensitive plants. Do not apply if wind speed exceeds 10 mph. Topramazone is rainfast in 1 hour. Topramazone can be used on field corn (grain, silage, and seed) and sweet corn.

### ImpactZ

topramezone (27) + atrazine (5)

**Rate:** 8-10.7 fl oz/a

**Adjuvants:** For best results, use MSO at 1-1.5% v/v plus either UAN at 1.25-2% v/v or AMS at 8.5-17 lbs/100 gal. Use the higher labeled rates when making application during periods of hot dry weather and to larger weeds. In tank mixtures with oil-based residual corn herbicides, a reduced adjuvant rate is recommended to reduce temporary

foliar corn injury. NIS at 0.25% v/v may be used in place of MSO under conditions of tender corn foliage in early season applications or if required in mixtures with other herbicides (Ex. dicamba, 2,4-D).

**Crop Stage:** Apply from emergence up to 12-inch corn or until 45 days before harvest, whichever occurs first.

**Weed Timing:** For best results, apply to emerged actively growing weeds less than 4 inches in height. See label for detailed list of maximum weed heights by species.

**Remarks:** ImpactZ is recommended to be used sequentially or tank-mixed with other corn herbicides to provide both broader spectrum and residual weed control. When tank mixing or sequentially applying atrazine products, do not exceed the maximum allowable atrazine active ingredient rate limits listed in Table 2-1.

### Impact Core

topramezone (27)  
+ acetochlor (15)

**Rate:** 20-40 fl oz/a. Rate dependent on % soil organic matter and texture, see label for details.

**Adjuvants:** For Impact Core alone - add 0.25% to 0.5% v/v methylated seed oil (MSO) OR 0.125% to 0.25% high surfactant methylated seed oil concentrate (HSMOC) AND add 1.25-2.5% of 28-34% UAN OR 1.5-2.5 lb/a of spray grade AMS ammonium sulfate. For tank mixtures with Impact Core - Use NIS at 0.25% v/v plus a nitrogen source. MSO and HSMOC adjuvants may be used however they can cause more serious leaf burn.

**Crop stage:** Apply from emergence (spike stage) up to 11-inch tall corn. Do not make applications within 45 days of harvest.

**Weed Timing:** Apply to small, actively growing grass and broadleaf weeds for effective postemergence control. POST control of weeds will be very similar to that of Impact. The acetochlor component of Impact Core provides residual control or partial control of certain small seeded broadleaf weeds and many grass species if an activating rainfall is received within 7 days after application.

**Remarks:** Up to two sequential applications may be made during a growing season. Applications must be separated by 14 days or more and must not exceed a cumulative total of 40 fl oz/a per year. Topramazone works synergistically with atrazine, so tank mixtures with 0.25-0.5 lb/a atrazine are recommended for enhanced control of emerged broadleaf and grass weeds. Higher rates of atrazine will provide additional residual weed control. It can also be tank mixed with most other postemergence herbicides, including glyphosate and Liberty 280 SL, on resistant hybrids, to enhance control of emerged grasses. Impact Core can be used on field corn (grain, silage, and seed) and popcorn.

## **Instigate** rimsulfuron (2) + mesotrione (27)

**Rate:** 5.25-7.0 oz/a. 6 oz/a is recommended for most soils and application situations. Do not apply more than 6 oz/a to emerged corn. Use higher rates on fine soils or soils with >3% organic matter.

**Adjuvants:** Add COC at 1% v/v or NIS at 0.25% v/v PLUS either 28-32% UAN at 2 qt/a or AMS at 2 lb/a if applied to emerged weeds. COC plus ammonium nitrogen fertilizer is the preferred adjuvant system. When tank mixed with loaded glyphosate or glufosinate products COC/MSO/NIS is not required.

**Crop stage:** Apply up to 14 days before planting (PP/PPI) until after planting (PRE). Apply POST from spike through the V2 corn growth stage.

**Weed timing:** Will fit well in no-till systems that require a burndown of existing vegetation prior to corn planting and will provide residual activity of several grass and broadleaf weeds. Burndown activity will be greatly enhanced by the addition of paraquat, glyphosate, and/or 2,4-D products, and the residual activity will be greatly enhanced by the addition of acetochlor+atrazine premix herbicides.

**Remarks:** Instigate is similar to Realm Q herbicide; however, Instigate does not include the safener (isoxadifen) and therefore Realm Q should be used after V2 corn. Do not apply to coarse-textured soil with less than 1% organic matter. Do not tank mix with foliar-applied organophosphate insecticides as severe crop injury may occur. To avoid crop injury or antagonism, apply these products at least 7 days before or 3 days after the application of Instigate. Do not apply within 45 days of crop emergence where the organophosphate insecticide Counter 20G was applied as a treatment since crop injury may occur. Do not apply to corn grown for seed, popcorn, ornamental corn, or sweet corn.

## **Katagon** nicosulfuron (2) + tolpyralate (27)

**Rate:** 2.3-3.4 fl oz/a. Apply at 3.4 fl oz/a in cases of dense weed infestations.

**Adjuvants:** Add MSO or COC at 0.5-1% v/v or NIS at 0.25% v/v. MSO is the preferred adjuvant. UAN or liquid AMS at 2.5% v/v or spray grade AMS at 8.5 lbs/100 gal may also be added.

**Crop stage:** Apply from emergence up to the 5-collar (V5) growth stage or up to 20 inches tall, whichever occurs first.

**Weed timing:** Apply to small (<5-inch), actively growing broadleaf and grass weeds for control or suppression of labeled species. The addition of atrazine at 0.5-1.5 lb ai/acre will improve burndown and broaden the postemergence efficacy of Katagon. Higher rates of atrazine will also provide residual control of certain weed species.

**Remarks:** Corn has exhibited little to no sensitivity to Katagon, however, crop injury may be observed

when applied during stressful environmental conditions. Sequential applications of Katagon must be separated by at least 14 days. Do not apply more than 6.8 fl oz/a per year. Do not tank mix with 2,4-D containing products as severe grass control antagonism may occur. Do not tank mix with bentazon (Basagran) containing products or severe crop injury may occur. Katagon is registered for use on field corn. Do not apply to sweet corn or popcorn.

## **Keystone LA NXT/Keystone NXT**

acetochlor (15) + atrazine (5) + safener

See information under Acetochlor + Atrazine premix.

## **Laudis** tembotrione (27) + safener

**Rate:** 3 fl oz/a

**Adjuvants:** Add COC or MSO at 1% v/v PLUS either 28-32% UAN at 1.5 qt/a or AMS 8.5 lb/100 gal. MSO is preferred over COC for optimum weed control.

**Crop stage:** Apply from emergence up to the 8-collar (V8) stage.

**Weed timing:** Provides good control of many emerged broadleaf and grass weeds. Apply before broadleaf weeds exceed 6 inches and grass weeds exceed 3 inches and are not tillering. Laudis is most effective when mixed with 0.5 lb/a atrazine. If corn is taller than 12 inches tall, 6 fl oz/a of Brox can be substituted for atrazine. For added grass control, Laudis can be applied with glyphosate and glufosinate on resistant hybrids. Check the herbicide label for specific adjuvant recommendations for these tank mixtures. Laudis also has limited soil residual activity.

**Remarks:** With the safener in Laudis, field corn has excellent tolerance. Do not exceed a total of 6 fl oz/a per year. Sequential applications of Laudis must be made at least 7 days apart. Laudis can be applied to field, silage, seed, and sweet corn.

## **Lexar EZ** S-metolachlor (15) + atrazine (5) + mesotrione (27)

**Preplant/PRE Rate:** 2.25-3.4 qt/a. Apply 3 qt/a on soils with less 3% organic matter and 3.4 qt/a on soils with 3% organic matter or more. A rate as low as 2.25 qt/a can be used as part of a two-pass program with either glyphosate or glufosinate.

**POST Rate:** 2.25-3.4 qt/a. If applied alone use the same rate structure as the PRE timing. If tank mixed with glyphosate or glufosinate, the rate of Lexar EZ can be reduced to 2.25 qt/a.

**Adjuvants:** Add NIS at 0.25% v/v or COC at 1% v/v if weeds are emerged at time of application. Do not use MSO. A nitrogen-based adjuvant (AMS or UAN) can be used when tank mixed with glyphosate or glufosinate. Otherwise, it is not recommended to

use nitrogen-based adjuvants as the risk of crop injury will increase.

**Crop stage:** Preplant up to 14 days, PRE, POST up to 12" corn

**Weed timing:** Provides residual control/suppression of many broadleaf and grass species. Lexar EZ also provides control of small (less than 3 inches), emerged broadleaf weeds. Will not provide consistent control of most emerged grass weeds.

**Remarks:** Lexar EZ may be applied as a split application. Apply 1.5-1.9 qt/a PRE, followed by a second application at 1.25-1.5 qt/a after corn emergence. The total amount of Lexar EZ can not exceed 3 qt/a in soils with less than 3% organic matter and 3.4 qt/a on soils with 3% organic matter or more. Lexar EZ will require a tank mix partner to control emerged grasses. Lexar EZ applied to emerged corn after organophosphate insecticide use may cause injury. Lexar EZ has a higher atrazine load than Lumax EZ. Refer to table 2-1 for the maximum allowable atrazine active ingredient rates for your scenario.

## **Lumax EZ** S-metolachlor (15) + atrazine (5) + mesotrione (27)

**Preplant/PRE Rate:** 2-3.25 qt/a. Apply 2.7 qt/a on soils with less 3% organic matter and 3.25 qt/a on soils with 3% organic matter or more. A rate as low as 2 qt/a can be used as part of a two-pass program with either glyphosate or glufosinate.

**POST Rate:** 2-3.25 qt/a. If applied alone use the same rate structure as the PRE timing. If tank mixed with glyphosate or glufosinate, the rate of Lexar EZ can be reduced to 2 qt/a.

**Adjuvants:** Add NIS at 0.25% v/v or COC at 1% v/v if weeds are emerged at time of application. Do not use MSO. A nitrogen-based adjuvant (AMS or UAN) can be used when tank mixed with glyphosate or glufosinate. Otherwise, it is not recommended to use nitrogen-based adjuvants as the risk of crop injury will increase.

**Crop Stage:** Preplant up to 14 days, PRE, POST up to 12" corn

**Weed Timing:** Provides residual control/suppression of many broadleaf and grass species. Lumax EZ also provides control of small (less than 3 inches), emerged broadleaf weeds. Will not provide consistent control of most emerged grass weeds.

**Remarks:** Lumax EZ may be applied as a split application. Apply 1.35-1.625 qt/a PRE, followed by a second application at 1.35-1.625 qt/a after corn emergence. The total amount of Lumax EZ can not exceed 2.7 qt/a in soils with less than 3% organic matter and 3.25 qt/a on soils with 3% organic matter or more. Lumax EZ will require a tank mix partner to control emerged grasses. Lumax EZ applied to emerged corn after organophosphate insecticide use may cause injury. The amount of

atrazine in Lumax EZ will not exceed atrazine rate limits. Additional atrazine or simazine can be tank mixed for added broadleaf control.

### Liberty 280 SL glufosinate (10)

**Rate:** 32-43 fl oz/a

**Adjuvants:** AMS at 1.5-3 lbs/a. Higher rates are recommended under unfavorable growing conditions. An anti-foam agent is recommended. The Liberty 280 SL formulation contains built in surfactants.

For additional use guidelines see information under glufosinate.

### Maverick pyroxasulfone (15) +mesotrione (27) + clopyralid (4)

**PP/PPI/PRE Rate:** 18-32 fl oz/a; Maximum use rates vary by soil texture. *Coarse:* 18 fl oz/a; *Medium:* 24 fl oz; *Fine:* 32 fl oz. Use the higher labeled rate for early preplant applications and in fields with high residue/reduced tillage.

**POST Rate:** 14 fl oz/a.

**Adjuvants:** Add NIS at 0.25% v/v or COC at 1% v/v if applying to emerged weeds. COC may result in temporary crop injury. Do not use nitrogen-based adjuvants or MSO with Maverick applied alone. AMS should only be used in tank mixtures containing glyphosate or glufosinate.

**Crop stage:** Apply from up to 28 days prior to planting (PP/PPI/PRE) through V6 or 18-inch corn (POST). PPI applications should be made within 14 days of planting and incorporated into the upper 2 inches of soil.

**Weed timing:** Provides early season residual control/suppression of many broadleaf and grass species. The addition of atrazine will improve residual control of large-seeded broadleaves such as giant ragweed. Maverick also provides control of small (less than 3 inches), emerged broadleaf weeds. Can be used to improve burndown activity in preplant applications to emerged weeds. Will not provide consistent control of most emerged grass weeds. Tank mix with glyphosate or glufosinate to control emerged weeds and provide in-season residual control after application.

**Remarks:** Can apply as a PRE/POST split application with 18 fl oz applied PRE followed by 14 fl oz POST to fine soils only. Do not apply more than 32 fl oz per year on any soil type except coarse soils. Do not apply more than 18 fl oz per year on coarse soils. Not recommended on soils with more than 10% organic matter. Do not apply POST with liquid fertilizer as a carrier as it will cause severe crop injury.

### metribuzin metribuzin (5)

There are many brands of metribuzin available for use. Most metribuzin products are formulated as either a dry granular containing 75% active ingredient ai (Tricor DF, Glory, Dimetric, etc.) or a liquid containing 4 lb ai/gal (Tricor 4F, Glory 4L, Mauler, etc). See individual product labels for specific product use guidelines and restrictions.

**Burndown/PRE Rate:** metribuzin 75DF: 2-5.3 oz/a when applied 10-30 days preplant; 2-4 oz/a when applied 9 days preplant to PRE. metribuzin 4L: 3-8 fl oz/a when applied 10-30 preplant; 3-6 fl oz/a when applied 9 days preplant to PRE. Use higher rates for heavy weed infestations.

**POST Rate:** metribuzin 75DF: 2-3 oz/a. metribuzin 4L: 3-4.5 fl oz/a.

**Adjuvants:** Add NIS or either UAN or AMS if applying to emerged weeds. Never use COC when applied to emerged corn. Consult the label for adjuvant recommendations for specific tank mixes.

**Crop stage:** Apply up to 30 days before planting as part of a burndown program or PRE for residual control. Apply POST from emergence until just prior to corn tasseling, but timing is restricted by the tank-mix partner.

**Weed timing:** Metribuzin can aid in burndown control of several broadleaf weeds. Burndown applications should also include an appropriate tank mix partner (see label for recommendations). Maximum size of broadleaf weeds controlled depends on the tank-mix partner. Metribuzin can be tank mixed with most residual corn herbicides to assist with residual control of labeled broadleaf weeds, including lambsquarters, pigweed, common ragweed, and velvetleaf. The amount of residual activity will depend on the rate and time of application.

**Remarks:** Do not apply more the 0.25 lb a.i./a per growing season. Do not apply more the 4 oz/a metribuzin 75DF or 6 fl oz/a metribuzin 4L on soils with <2% OM. Do not apply on soils with a pH>7.0 or coarse soils with <1.5% OM. When applied POST, metribuzin may cause some corn leaf burn, but the effects are generally temporary. Metribuzin may be used on field corn, silage corn, and seed corn varieties that are known to be tolerant.

### NorthStar primisulfuron (2) + dicamba (4)

**Rate:** 2.5-5 oz/a

**Adjuvants:** Add NIS at 0.25% v/v or COC at 1-4 pt/a if corn is less than 12 inches tall. Adding 2-4 qt/a of 28% UAN or 2-4 lb/a AMS may improve the control of some weeds.

**Crop stage:** Apply to 4-20-inch corn. Applications before 4 inches may cause injury and after the V-6 stage may cause pinched ears. Use drop nozzles for corn from 20-36 inches tall.

**Weed timing:** Apply to small actively growing grass and broadleaf weeds. Consult label for optimum weed heights. Can be tank mixed with atrazine, dicamba, Halex GT, glyphosate, or Resource to improve broadleaf weed control or tank mixed with glyphosate or Accent Q for added annual grass control.

**Remarks:** Corn occasionally may show temporary yellowing or leaning/brittleness (from the dicamba component) after application. Delay cultivation until normal growth occurs to prevent stalk breakage. To prevent residues from injuring other crops like soybeans, use an ammonia solution to clean the sprayer after use. Do not apply NorthStar if Counter 20G was applied in furrow. NorthStar applied after surface-banded or T-banded Counter 20G may cause injury. NorthStar applications after Dyfonate, Lorsban, and Thimet may also cause temporary injury. NorthStar can be used on IR corn hybrids regardless of insecticide use without increasing risk of injury, but IT corn hybrids should be treated as conventional hybrids. NorthStar can be used on field corn, silage corn, and seed corn.

### Outlook dimethenamid-P (15)

**Rate:** 12-21 fl oz/a; *Less than 3% OM:* coarse 12-14 fl oz; medium/fine 14-18 fl oz. *More than 3% OM:* coarse 14-18 fl oz; medium/fine 18-21 fl oz. Reduced rates of 8-16 fl oz may be used as part of a planned sequential 2-pass herbicide program. Use 21 fl oz/a for all early preplant applications and on muck and high organic matter soils.

**Adjuvants:** Add adjuvants according to requirements of the tank-mix partner.

**Crop stage:** Apply up to 45 days prior to planting (PP). Split applications can be made 30-45 days before planting with 2/3 of the rate applied initially and the remaining 1/3 applied at planting. PPI applications should be made within 14 days of planting and incorporated into the upper 1-2 inches of soil. Apply during or shortly after planting (PRE) up to 12 inch corn (POST). Layby applications can be made to corn 12-36 inches tall but should be directed beneath the corn canopy.

**Weed timing:** Provides residual control of annual grasses and small-seeded broadleaf weeds. Will not control emerged weeds so a tank-mix partner is generally necessary for initial control with Outlook providing residual grass control. Outlook can be tank-mixed with many other corn herbicides to broaden the spectrum of control and to increase the length of residual. Check label for common PRE and POST tank mix recommendations.

**Remarks:** If Outlook is applied in two split applications, do not exceed the seasonal total of 24 fl oz/a and separate applications by at least 14 days. In dry seasons, preplant-incorporated treatment provides

better annual weed control than preemergence treatment. Outlook generally doesn't injure corn; however, Outlook-treated corn sprouting in cold, wet soil may occasionally leaf out underground. Can be mixed with liquid fertilizer or impregnated onto certain dry fertilizers for simultaneous application. It may be used on field corn, silage corn, sweet corn, and seed corn.

---

### Permit halosulfuron (2)

**Rate:** 0.67-1.33 oz/a

**Adjuvants:** NIS, COC, N, AMS; Add nonionic surfactant at 0.25% or crop oil concentrate at 1% to the spray mixture. A 28% nitrogen solution may be added at 2-4 qt/a or ammonium sulfate at 2-4 lb/a if required by a tank-mix partner.

**Crop stage:** Apply from emergence to lay-by stage (about 36 inches tall).

**Remarks:** Can be tank mixed with atrazine, Brox, dicamba, or 2,4-D to broaden the spectrum of broadleaf weed control. Tank mixtures can also be made with Accent Q to control specific grasses. Corn has good tolerance to Permit. Permit can be applied to field corn, silage corn, and seed corn, but not sweet corn.

---

### Princep 4L simazine (5)

**Rate:** 2 qt/a

**Crop stage:** Preplant incorporated, apply and incorporate within 14 days before planting or preemergence prior to corn emergence.

**Remarks:** In dry seasons, preplant-incorporated applications provide better annual weed control than preemergence applications. Atrazine has largely replaced Princep 4L because of its greater water solubility, less rainfall is necessary to make it effective. Nonetheless if rainfall is adequate, Princep 4L will control annual weeds nearly equal to atrazine. Princep 4L can be used as an atrazine substitute in atrazine prohibition areas. Princep 4L can be tank mixed with acetochlor, atrazine, Dual II Magnum, or Outlook. The longer soil residual of Princep 4L may be of value in conservation tillage. Where corn will be planted directly into a sod, cover crop, or previous crop residue, Princep 4L may be tank mixed with Gramoxone. Can be mixed with liquid fertilizer for simultaneous application. Princep 4L may be used on field corn, silage corn, and sweet corn.

---

### Prowl H2O pendimethalin (3)

**Rate:** 2-4 pt/a

**Crop stage:** Apply after planting up 30 inches tall or V8 corn growth stage. Do not apply Prowl before planting.

**Weed timing:** Provides residual control of many

annual grasses and some small seeded broadleaves. Will not control emerged weeds. To improve broadleaf control tank mix with an approved herbicide such as atrazine.

**Remarks:** Apply only after corn planting and be certain that the seed furrow has been thoroughly closed and leveled before treatment. Plant corn at least 1.5 inches deep. Corn seed contact with Prowl H2O will cause stand loss. Prowl H2O is ineffective on peat and muck soils. Under cold, wet conditions, Prowl H2O may cause stunting and yellowing of seedling corn. It may also cause root pruning and occasional lodging. Do not soil-incorporate or corn injury will occur. Do not apply ahead of planting because the planter shoe may incorporate sufficient Prowl H2O into the seed furrow to damage corn. If post-plant tillage is necessary to break a soil crust or to control weed escapes, use shallow tillage such as a rotary hoe or shallow row cultivation. Preemergence-applied Prowl H2O can be mixed with liquid fertilizer for simultaneous application. Preemergence application may be made to field corn, silage corn, and processing varieties of sweet corn.

---

### Python flumetsulam (2)

**PP/PPI/PRE Rate:** 0.8-1.33 oz/a. *Coarse:* 0.8-1 oz/a; *Medium/Fine:* 0.89-1.33 oz/a. Within soil textural class, use the higher rate range on soils with >3% organic matter.

**POST Rate:** 0.8-1.14 oz. *Coarse:* 0.8-0.89 oz/a; *Medium/Fine:* 0.89-1.14 oz/a

**Adjuvants:** Add NIS at 0.25% v/v or COC at 1% v/v if applying to actively growing weeds. Under dry conditions, use of UAN at 2.5% v/v or sprayable AMS at 2-4 lb/a may enhance control.

**Crop stage:** Apply early preplant up to 20 inches tall or V6 stage corn. For PPI applications incorporate into the top 2-3 inches of soil within 30 days of planting. The lower rates within each soil texture category need to be applied within 14 days of planting. Applications to spike stage corn are permitted.

**Weed timing:** Provides residual and burndown control of several labeled broadleaf weeds. Python is very effective at controlling velvetleaf up to 8 inches tall. Python can be tank mixed with other grass or broadleaf herbicides to expand the spectrum of weeds controlled.

**Remarks:** Do not use on peat or muck soils or on soils with pH less than 5.9 and organic matter above 5% because of reduced weed control. May cause stunting, which may be due to corn emerging in cold soils or other factors. To minimize the risk of injury, plant corn at least 1.5 inches deep and use on soils with at least 1.5% organic matter. Do not use if soil pH is greater than 7.8 and organic matter

is less than 3% to avoid crop injury. Do not use if Counter 20G or Thimet have been applied. Apply other soil insecticides in a T-band or surface band to avoid crop injury when using this herbicide. Can be mixed with liquid fertilizer or impregnated onto certain dry fertilizers for simultaneous applications. Python can be applied to field corn, silage corn, or tested seed corn lines.

---

### Realm Q rimsulfuron (2) + mesotrione (27) + safener

**Rate:** 4 oz/a

**Adjuvants:** Add COC at 1% v/v PLUS either 28-32% UAN at 2 qt/a or AMS at 2 lb/a. NIS at 0.25% v/v can also be used, but COC is preferred.

**Crop stage:** Apply to corn up to 20 inches or V7 whichever is more restrictive. Apply before 12-inch corn for best performance.

**Weed timing:** Will control or suppress several small annual grass and broadleaf weeds and provides limited residual control. Suggested for use during early POST applications as a sequential weed control component following a foundational PRE corn herbicide program. Can be tank mixed with glyphosate or glufosinate products for application on resistant hybrids, and with a variety of other POST corn herbicides to improve the spectrum of weed control.

**Remarks:** Do not exceed the total annual limits of rimsulfuron or mesotrione. Rainfall or irrigation is needed within 5-7 days following application to provide residual control. Do not tank mix with Basagran because severe crop injury may occur. Do not mix Realm Q with foliar-applied organophosphate insecticides, such as Lorsban, malathion or parathion, as severe crop injury may occur.

---

### Resicore/Resicore XL acetochlor (15) + mesotrione (27) + clopyralid (4) + safener

\*Resicore XL is a new formulation of Resicore with encapsulated acetochlor and a different safener (benoxacor). Use rates of both products are the same; however, Resicore XL can be applied POST up to 24 inches tall corn.

**Rate:** 2.25-3.25 qt/a; Rates vary by soil type and % organic matter. *Less than 3% OM:* coarse—2.25 qt; medium—2.5 qt; fine—2.75 qt. *More than 3% OM:* coarse—2.5 qt; medium—2.75 qt; fine—3.0 qt. May use an additional 0.25 qt/a in areas of heavy weed infestation. Can be applied at a rate as low as 1.8 qt/a as part of a 2-pass weed control system.

**Adjuvants:** Add NIS at 0.25% v/v or COC at 1% v/v if applying to emerged weeds. COC may result in temporary crop injury. Do not use nitrogen-based adjuvants or MSO with Resicore applied alone. AMS

should only be used in tank mixtures containing glyphosate or glufosinate.

**Crop stage:** Apply from up to 28 days prior to planting (PP/PPI/PRE) through 11-inch corn *Resicore* or 24-inch corn *Resicore XL* (POST). PPI applications should be made within 14 days of planting and incorporated into the upper 1-2 inches of soil.

**Weed timing:** Provides early season residual control/suppression of many broadleaf and grass species. The addition of atrazine will improve residual control of large-seeded broadleaves such as giant ragweed. *Resicore/Resicore XL* also provides control of small (less than 3 inches), emerged broadleaf weeds. Can be used to improve burndown activity in preplant applications to emerged weeds. Will not provide consistent control of most emerged grass weeds. Tank mix with glyphosate or glufosinate to control emerged weeds and provide in-season residual control after application.

**Remarks:** *Resicore/Resicore XL* can be applied as a split-application with 50% of the labeled rate applied prior to emergence and 50% (minimum of 1.25 qt/a) of the rate applied POST. Not recommended on soils with more than 10% organic matter. Do not apply POST with liquid fertilizer as a carrier as it will cause severe crop injury. Temporary leaf burn may result from POST applications but will not affect later growth or yield.

### Resolve Q rimsulfuron (2) + thifensulfuron (2) + safener

**PP/PPI/PRE Rate:** 1.25-2.5 oz/a. 1.25-1.5 oz/a fits most preemergence/preplant applications. Incorporation should be less than 2 inches deep.

**POST Rate:** 1.25 oz/a

**Adjuvants:** Add COC/MSO at 1% v/v or NIS at 0.25% v/v PLUS an ammonium nitrogen fertilizer such as AMS at 2 lb/a or UAN at 2 qt/a. COC/MSO plus ammonium nitrogen fertilizer is the preferred adjuvant system. An adjuvant may not be required if tank mixing with a glyphosate or glufosinate formulation that already contains all the necessary adjuvant (fully loaded).

**Crop stage:** Can apply preplant burndown, preplant incorporated or PRE after planting. Can apply POST up to 20-inch corn or V6 growth stage, whichever is more restrictive.

**Weed timing:** Will control or suppress many small (1 to 2 inch) annual grass and broadleaf weeds and provide residual control of labeled weeds. Good residual activity on velvetleaf, pigweed, lambsquarters, and foxtails. Can be tank mixed with several other PRE or POST herbicides to improve the spectrum of control.

**Remarks:** Resolve can be used on field corn but not seed or sweet corn. Consult the label for informa-

tion about possible interactions between Resolve Q and insecticides.

### Resource flumiclorac (14)

**Rate:** 4-8 fl oz/a; Rates are restricted based on application method with broadcast applications limited to 4-6 fl oz/a, drop-nozzle applications limited to 4-8 fl oz/a, and tank mixtures limited to 4 fl oz/a.

**Adjuvants:** Add COC at 1 pt/a for broadcast application or 2 pt/a for drop nozzle applications. See label for tank mixture recommendations.

**Crop stage:** Apply from V-2 to V-10 (2- to 10-collar) stage. Tank mix applications can be made from V-2 through the maximum stage allowed by the tank-mix partner.

**Remarks:** May cause temporary spotting of corn leaves. Must be applied early for consistent control. Can be tank mixed at low rates with numerous broadleaf herbicides to enhance the velvetleaf control of the tank-mix partner. Resource may be used on field corn and silage corn but not on sweet corn.

### Restraint tolpyralate (27) + acetochlor (15)

**Rate:** 30-48 fl oz/a. Coarse textured soil – 30 fl oz; Medium – 30-36 fl oz; Fine, less than 3% organic matter – 30-36 fl oz; Fine, greater than 3% OM – 36-48 fl oz.

**Adjuvants:** Add COC at 1% v/v or NIS at 0.25% v/v.

**Crop Stage:** Apply preplant up to 30 days before planting, preemergence, or postemergence up to 20 inches tall or V6 growth stage corn, whichever occurs first. Do not apply within 45 days of field corn and popcorn harvest.

**Weed timing:** Apply to small (<5-inch), actively growing broadleaf and grass weeds for control or suppression of labeled species. The addition of atrazine at 0.5-1.5 lb ai/acre will improve burndown and broaden the postemergence efficacy of Shieldex. Higher rates of atrazine will also provide residual control of certain weed species. The acetochlor component of Restraint will provide residual control of annual grasses and certain small seeded broadleaves if an activating rainfall occurs within one week of application.

**Remarks:** Corn has exhibited little to no sensitivity to Restraint, however, crop injury (leaf necrosis) may be observed when applied during stressful environmental conditions. Sequential applications of Restraint must be separated by at least 14 days. Do not apply more the 60 fl oz/a per year. Restraint is registered for use on field corn, sweet corn, and popcorn but do not apply POST to sweet corn.

### Revulin Q nicosulfuron (2) + mesotrione (27) +safener

**Rate:** 3.4-4.0 oz/a

**Adjuvants:** Add COC at 1% v/v or HSOC at 0.5% v/v PLUS either AMS at 2 lbs/a or UAN at 1.25-2.5%. MSO is not recommended because it may cause severe crop injury.

**Crop stage:** Apply to corn up to V-8 or 30 inches in field corn, V-6 or 18 inches in sweet corn, or V-5 or 20 inches in seed/popcorn. Avoid spraying into the whorl in later applications. Use drop nozzles from 12-18 inch tall sweet corn and 20-30 inch tall field or seed corn.

**Weed timing:** For best results apply to small, actively growing weeds. Best used in a two-pass program with a PRE herbicide application.

**Remarks:** Do not tank mix with Basagran. Do not mix with foliar-applied OP insecticides such as Lorsban, malathion, or parathion, as severe crop injury may occur. Apply at least 7 days before Revulin Q or 3 days following. If Counter is applied in furrow, do not apply within 45 days of emergence.

### Sharpen saflufenacil (14)

**Rate:** 1-3.5 fl oz/a; ; Rates vary by soil type; coarse–2-2.5 fl oz; medium–2.5-3 fl oz; fine–3-3.5 fl oz. Can be applied at 1 fl oz/a as part of a preplant burndown application if limited or no residual control is desired.

**Adjuvants:** Add MSO at 1% v/v plus AMS at 8.5-17 lb/100 gal or UAN at 1.25-2.5% v/v in burndown situations.

**Crop stage:** Apply up to 30 days prior to planting (PP) until shortly after planting (PRE) before corn emergence. PPI applications should be made within 14 days of planting and incorporated into the upper 1-2 inches of soil. Do not apply to emerged corn.

**Weed timing:** Sharpen can aid in the burndown of emerged broadleaf weeds less than 6" tall prior to planting, especially marehail. Can be tank mixed with Gramoxone, glyphosate, or glufosinate to increase burndown activity and to control emerged grasses. Early season broadleaf residual control will be obtained with Sharpen applied at the proper rate for the soil type (2-3.5 fl oz/a). The addition of atrazine will improve residual control of large-seeded broadleaves such as giant ragweed. Sharpen is intended for use in a planned PRE followed by POST program.

**Remarks:** Sharpen has good crop tolerance but may cause injury under stressful growing conditions. Do not apply more than 6 fl oz/a Sharpen per cropping season. Do not use on sands with less than 3% organic matter. Do not apply Sharpen at more than 1 fl oz/a where an at-planting application of and OP or carbamate insecticide is planned and/or has occurred (see label for exceptions).

## Shieldex 400SC

tolpyralate (27)

**Rate:** 1.0-1.35 fl oz/a. Apply at 1.35 fl oz/a in cases of dense weed infestations.

**Adjuvants:** Add MSO or COC at 0.5-1% v/v or NIS at 0.25% v/v. MSO is the preferred adjuvant. UAN or liquid AMS at 2.5% v/v or spray grade AMS at 8.5 lbs/100 gal may also be added.

**Crop stage:** Apply from emergence up to 20 inches tall or V6 growth stage corn, whichever occurs first. Do not apply within 45 days of field corn and popcorn harvest or within 35 days of sweet corn harvest.

**Weed timing:** Apply to small (<5-inch), actively growing broadleaf and grass weeds for control or suppression of labeled species. The addition of atrazine at 0.5-1.5 lb ai/acre will improve burn-down and broaden the postemergence efficacy of Shieldex. Higher rates of atrazine will also provide residual control of certain weed species.

**Remarks:** Corn has exhibited little to no sensitivity to Shieldex, however, crop injury (leaf necrosis) may be observed when applied during stressful environmental conditions. Sequential applications of Shieldex must be separated by at least 14 days. Do not apply more than 2.7 fl oz/a per year. Shieldex is registered for use on field corn, sweet corn, and popcorn.

## Sinate

topramezone (27) +  
glufosinate (10)

**Rate:** 21-28 fl oz/a. Use higher rate within the range for control of larger weeds.

**Adjuvants:** Add methylated seed oil (MSO) at 1% v/v OR high surfactant methylated oil concentrate (HSMOC) at 0.5-0.75% v/v AND spray grade AMS at 3 lb/a. A liquid AMS product may be used which provide an equivalent rate of AMS per acre. COC may be used at 1% v/v but MSO and HSMOC adjuvants are preferred.

**Crop stage:** For Liberty tolerant corn hybrids only. Apply from emergence up to 24 inches tall or V7 growth stage corn, whichever occurs first. May be applied up to 36 inches tall corn if drop nozzles are used. Do not apply within 60 days of harvesting corn for forage or within 70 days of harvesting grain.

**Weed timing:** Apply to small, actively growing weeds before weeds exceed the maximum height listed on the label. Sinate requires uniform, thorough spray coverage for good control, minimum of 15 GPA. The addition of atrazine at 0.25-0.5 lb ai/a will significantly increase weed activity of Sinate on emerged weeds.

**Remarks:** Do not apply more than 28 fl oz/a per year. Can be applied to LibertyLink sweet corn hybrids at 21 fl oz/a from emergence up to the

V6 growth stage. Do not apply within 50 days of harvesting sweet corn ears.

## Stalwart C

metolachlor (15)

See information under Dual II Magnum.

## Stalwart Xtra Lite

metolachlor (15) +  
atrazine (5)

**Rate:** 1.25-3.0 qt/a. Rate is dependent on application timing, soil texture, and % organic matter, see label for details.

**Adjuvants:** Include adjuvants according to requirements of the tank-mix partner if applying to emerged weeds.

**Crop stage:** For coarse textured soils, apply within 14 days of planting. For medium/fine textured soils, apply up to 45 days preplant. Applications made more than 30 days before planting should be part of a split application with 2/3 of the rate applied initially and the remaining 1/3 at planting. For PPI applications, incorporate into the top 2 inches of soil within 14 days before planting. Can be applied POST up to 5-inch corn or as a directed application to 12-inch corn.

**Weed timing:** Provides good to excellent residual control of foxtails, crabgrass, fall panicum, and most annual broadleaf weeds. Some velvetleaf and giant ragweed may escape. Can be tank mixed with many corn PRE herbicides to enhance broadleaf weed control. The atrazine component will also provide burndown activity on small annual broadleaf weeds but generally will not control emerged annual grasses unless they have only one or two leaves. Larger emerged weeds need to be controlled by a tank-mix partner, like glyphosate or glufosinate, on resistant hybrids.

**Remarks:** This premix contains the correct ratio of atrazine to s-metolachlor to maintain the full rate of s-metolachlor with the maximum allowable rate of atrazine for Wisconsin. Do not use on peat or muck soils. Can be mixed with liquid fertilizer for simultaneous preplant-incorporated or preemergence applications and can also be impregnated onto certain dry fertilizers.

**Stalwart 3W** metolachlor (15) + atrazine (5)  
+ mesotrione (27)

See information under Lexar EZ.

## Status

dicamba (4) + diflufenzopyr (19) +  
safener

**Rate:** 5-10 oz/a; Can be tank mixed at 2.5 oz/a with glyphosate or glufosinate on resistant corn hybrids.

**Adjuvants:** Add NIS at 0.25% v/v or COC at 1% v/v

PLUS either 28-32% UAN at 1.25% v/v or AMS at 5 lb/100 gal.

**Crop stage:** 4-36 inches tall or V10 corn

**Weed timing:** Broadleaf weeds should be treated before weed competition occurs and while weeds are still easily controlled (less than 4 inches in height). Status controls many annual broadleaf weeds and suppresses perennial broadleaves. Status may also suppress growth of annual grasses that escape control after a PRE grass herbicide application but do not rely on Status for annual grass control. Can be tank mixed with other POST grass or broadleaf herbicides with the following exceptions — dicamba, Hornet WDG, Northstar, and 2,4-D. Tank mixing with emulsifiable concentrate formulations of residual grass herbicides are not recommended because of potential injury.

**Remarks:** Corn injury (stalk brittleness or twisting) should be less than injury from other dicamba products because of the safener added to the formulation. Soybeans, tobacco, and most vegetable are extremely sensitive to Status, so avoid drift. To prevent residues from injuring other crops like soybeans, the sprayer should be cleaned after use with a strong detergent or spray tank cleaner. Status can be used on field corn, silage corn, and seed corn but not on sweet corn.

## Steadfast Q

nicosulfuron (2) +  
rimsulfuron (2) + safener

**Rate:** 1.5 oz/a

**Adjuvants:** Add crop oil concentrate at 1% (preferred) or nonionic surfactant at 0.25% to the spray solution. Also add 2 qt/a of 28% nitrogen solution or 2 lb/a ammonium sulfate.

**Crop stage:** Apply from emergence to 20 inches, but before the 7-collar (V-7) stage. For corn with 77-88-day maturities, apply before 12 inches or V-6 stage.

**Remarks:** Do not add a nitrogen fertilizer if tank mixing with Lumax EZ. Steadfast Q is labeled for tank mixtures with lower rates of atrazine, Callisto, dicamba, Hornet, Impact/Armezon plus atrazine, or Status to provide broadleaf weed control. Tank mixing Steadfast Q with dicamba may increase the risk of rat-tailing when applied to small corn. Do not tank mix Steadfast Q with Basagran, or 2,4-D because crop injury or antagonism may occur. Only tank mix with ALS herbicides when recommended by DuPont. Do not apply to hybrids with relative maturities of less than 77 days or injury may occur. Do not use Steadfast Q on fields treated with Counter 20G applied in furrow at planting or over the row at cultivation. Steadfast Q may injure corn treated with Counter 20G, Lorsban, or Thimet if soil has less than 4% organic matter. Do not apply organophosphate insecticides within 7 days before

or 3 days after Steadfast Q applications. Steadfast Q may only be used on field and silage corn.

### Stinger/Stinger HL clpyralid (4)

**Rate:** *Stinger*: 4-11 fl oz/a. *Stinger HL*: 2.4-6.4 fl oz/a. Use the higher rate within the range for heavy infestations or when greater residual control is required.

**Adjuvants:** Addition of an adjuvant is not usually required.

**Crop stage:** Apply from emergence through 24 inches tall.

**Weed timing:** Apply to emerged actively growing weeds up to 5 leaves. Controls many weeds in the sunflower family including cocklebur, sunflower, common and giant ragweed, Jerusalem artichoke, and Canada thistle plus some weeds in the nightshade, buckwheat, and legume families. For Canada thistle control, apply 5-11 fl oz (Stinger) or 3-6.6 fl oz (Stinger HL) when thistles are at least 4 inches but prior to the bud stage. Provides limited residual activity on certain broadleaf species but is not a standalone PRE product.

**Remarks:** If Hornet WDG or other clpyralid containing herbicide is applied preemergence make sure not to exceed a season use rate of 0.25 lb ae per acre.

### Storen S-metolachlor (15) + pyroxasulfone (15) + mesotrione (27) + bicyclopyrone (27)

**Rate:** 2.1-2.4 qt/a; 2.1 qt/a is recommended for soils with less than 3% organic matter, otherwise use 2.4 qt/a. May be applied as a split application. Apply 1/2 to 2/3 of the labeled rate PRE, followed by 1/2 to 1/3 of the labeled rate POST. For extended residual or control of heavy weed infestations 2.4 qt/a may be applied to medium and fine textured soils with less than 3% organic matter. Reduced rates may be used PRE when applied as part of a planned 2-pass herbicide program (see label for details).

**Adjuvants:** Add NIS at 0.25% v/v if weeds are present. In addition to NIS, AMS can be added at 8.5-17 lb/100 gal of water. COC may result in crop injury and if used do not exceed 1 qt/a. Do not use MSO or UAN if corn has emerged unless directed for a specific tank mix on the label.

**Crop stage:** Apply up to 28 days prior to planting (PP/PRE). Apply POST up to V8 corn. Do not apply POST to sweet corn or yellow popcorn.

**Weed timing:** Provides residual control/suppression of many broadleaf and grass species. Also provides control of small (less than 3 inches), emerged broadleaf weeds. Will not provide consistent control of most emerged grass weeds. Control of emerged grasses will require the addition

of another herbicide with grass activity. See label for the range of tank mix partners.

**Remarks:** Do not use on coarse textured soils or injury may occur. Applying Storen POST to corn that received an at-plant application of Counter insecticide can result in severe crop injury. Applying an organophosphate or carbamate insecticide within 7 days (before or after) of a POST application of Storen may result in severe corn injury. Not recommended for soils with 10% or more organic matter.

### SureStart II acetochlor (15) + clpyralid (4)+ flumetsulam (2)

**Rate:** 1.5-3.0 pt/a; Rates vary by soil type; coarse-1.5-2 pt; medium with <3% OM-1.5-2.5 pt; medium with >3% OM-1.75-3 pt; fine-2-3 pt.

**Adjuvants:** Add adjuvants according to requirements of the tank-mix partner.

**Crop stage:** Apply from 30 days prior to planting (PP/PPI/PRE) through 11-inch corn (POST). PPI applications should be made within 14 days of planting and incorporated into the upper 1-2 inches of soil. Do not make applications to coarse soils more than 21 days before planting.

**Weed timing:** Provides early season residual control of many annual grass and broadleaf weeds. SureStart II is intended for use in a planned PRE followed by POST program. SureStart II also has limited activity on emerged susceptible broadleaf weeds up to 2 inches tall, but will not control emerged grasses. Tank mix with glyphosate or glufosinate to control emerged weeds and provide in-season residual control after application.

**Remarks:** To minimize the risk of injury, plant corn at least 1.5 inches deep and use on soils with at least 1.5% organic matter and avoid soils with a pH above 7.8. Do not use on soils with a pH<5.9 and organic matter above 5% because of reduced weed control. Soil-applied OP insecticides should be applied in a T-band or banded to avoid injury and Counter 20G and Thimet should not be used. Surestart can be mixed with liquid fertilizer or impregnated onto certain dry fertilizers for simultaneous application. Use water as a carrier when making POST applications. It may be used on field corn and seed corn but not sweet corn.

### Surpass NXT acetochlor (15) + safener

See information under Harness.

### TripleFlex II acetochlor (15) + clpyralid (4) + flumetsulam (2)

See information under Surestart II.

### TriVolt isoxaflutole (27) + flufenacet (15) + thiencarbazone (2)

Labeled for use in Columbia, Dane, Dodge, Jefferson, Fond du Lac, Grant, Green, Lafayette, Rock, Sauk, Waukesha, and Walworth counties.

**Rate:** 10.75-20 fl oz/a; Rate is dependent on soil texture and % organic matter, see label for details. Rates of 10-12 fl oz/a can be used for planned two-pass weed control programs.

**Adjuvants:** Add COC or MSO at 1% v/v when applying to emerged weeds and prior to corn emergence. DO NOT use adjuvants when applying to emerged corn. NIS can be substituted for COC/MSO when mixing with liquid nitrogen fertilizer or certain glyphosate formulations.

**Crop stage:** Apply prior to corn emergence up to 21 days before planting (PP/PPI/PRE). May be applied up to 30 days prior to planting when used in a planned sequential program. For PPI applications, do not incorporate deeper than 2 inches. Apply early POST from corn spiking through V2 corn.

**Weed timing:** Provides effective residual control of many broadleaf and grass weeds. The addition of an atrazine containing product will improve weed control consistency. Will provide preplant burndown control of labeled weeds 6 inches or less in height when used with an appropriate adjuvant. For larger weeds include an appropriate tank mix partner. TriVolt may not provide control of emerged weeds larger than the 1 true leaf stage in early POST applications.

**Remarks:** TriVolt must be used in accordance with the Wisconsin Product Bulletin. Do not use COC, MSO, or a loaded glyphosate formulation with TriVolt applied to emerged corn. Tank-mixtures with herbicides other than atrazine are not recommended for early POST applications as crop response symptoms including bleaching, leave edge necrosis and stunting may result. Do not apply solo HPPD inhibitor POST herbicides to corn that has been previously treated with TriVolt. Cannot be used on soils classified as coarse-textured if depth to groundwater is less than 25 feet.

### Valor SX/Valor EZ flumioxazin (14)

**Rate:** Valor SX: 1-3 oz/a; Valor EZ: 1-3 fl oz/a

**Crop stage:** Apply 7-30 days before planting, depending on rate, residue cover, and rainfall.

**Weed timing:** Can be tank mixed with glyphosate, Gramoxone, 2,4-D, or other burndown herbicides to improve control of emerged broadleaf weeds. Valor SX will provide residual control of broadleaf weeds depending on rate. At a 1 oz/a rate with glyphosate, more rapid control may be observed plus limited residual suppression of annual broadleaf weeds, but this application must be made at least 2 weeks

before planting. At rates of 2-3 oz/a, residual annual broadleaf weed control should extend past corn planting.

**Remarks:** Can only be used in no-till fields where residue has not been incorporated. Should not be tank mixed with acetochlor, Dual, Outlook, or products containing these ingredients because of potential injury. Do not irrigate corn from emergence until after the V-2 stage. Valor SX can be used on field and silage corn but not on seed or sweet corn.

**Verdict** saflufenacil (14) +  
dimethenamid-P (15)

**Rate:** 10-18 fl oz/a; Rates vary by soil type; coarse—10-12 fl oz; medium—13-15 fl oz; fine—16-18 fl oz. Can be applied at 5 fl oz/a as part of a preplant burndown application if limited or no residual control is desired.

**Adjuvants:** Add MSO at 1% v/v PLUS either AMS at 8.5-17 lb/100 gal or UAN at 1.25-2.5% v/v if applied to emerged weeds as part of a preplant burndown application.

**Crop stage:** Apply up to 45 days prior to planting (PP) until shortly after planting (PRE). PPI applications should be made within 14 days of planting and incorporated into the upper 1-2 inches of soil. Do not apply to emerged corn.

**Weed timing:** Provides residual control of many annual grass and broadleaf weeds. The addition of atrazine will improve control of large-seeded broadleaves such as giant ragweed. Verdict is intended for use in a planned PRE followed by POST program. Verdict can also aid in the burndown of emerged broadleaf weeds prior to planting, especially marestail. It can be tank mixed with Gramoxone, glyphosate, or glufosinate to increase burndown activity and to control emerged grasses.

**Remarks:** Verdict is a premix of Sharpen and Outlook herbicides. At the 15 oz/a rate Verdict provides the equivalent of 3 oz/a Sharpen and 12.5 oz/a Outlook. Do not apply more than 25 fl oz/a Verdict per cropping season. Do not use on sands with less than 3% organic matter. Do not apply Verdict where an at-planting application of and OP or carbamate insecticide is planned and/or has occurred (see label for exceptions).

**Yukon** halosulfuron (2) + dicamba (4)

**Rate:** 4-8 oz/a

**Adjuvants:** NIS, COC, N, AMS; Add nonionic surfactant at 0.25-0.5% (preferred) or crop oil concentrate at 1% to the spray solution. If required by a tank-mix partner, 2-4 qt/a of 28% nitrogen solution or 2-4 lb/a ammonium sulfate may be added.

**Crop stage:** Apply from emergence to 36 inches.

**Remarks:** Yukon at 4 oz/a is equivalent to the

standard 0.67 oz/a rate of Permit plus 4 oz/a of dicamba. Yukon is labeled for tank mixtures with atrazine, Accent, Callisto, Impact/Armezon, and Steadfast Q. It can be tank mixed with glyphosate or Liberty 280 SL on resistant hybrids. Corn has good tolerance to early postemergence applications, but certain hybrids may have temporary twisting or brittleness because of the dicamba component. Soybeans, tobacco, and most vegetables are extremely sensitive to the dicamba component in Yukon, so avoid drift. To prevent residues from injuring other crops like soybeans, clean the sprayer after use with a detergent solution followed by an ammonia solution. Yukon can be used on field, silage, and seed corn but not on sweet corn.

**Zidua/Zidua SC** pyroxasulfone (15)

**PP/PPI/PRE Rate:** *Zidua*: 1.5-4.0 oz/a; Apply 1.5-2.75 oz for coarse soils, 2.0-3.0 oz - medium, and 2.5-4.0 oz - fine. *Zidua SC*: 2.5-6.5 fl oz/a; Apply 2.5-4.5 fl oz for coarse soils, 3.25-5.0 fl oz - medium, and 4-6.5 fl oz - fine.

**POST Rate:** *Zidua*: 1-4 oz/a; Apply 1.0-2.75 oz for coarse soils, 1.5-3.0 oz - medium, and 2.0-4.0 oz - fine.

*Zidua SC*: 1.75-6.5 fl oz/a; Apply 1.75-4.5 fl oz for coarse soils, 2.5-5.0 fl oz - medium, and 3.25-6.5 fl oz - fine.

**Adjuvants:** Add adjuvants according to requirements of the tank-mix partner.

**Crop stage:** Apply up to 45 days prior to planting (PP). PPI applications should be made within 14 days of planting and incorporated into the upper 1-2 inches of soil. Apply during or shortly after planting (PRE) up to the V4 corn growth stage (POST).

**Weed timing:** Provides residual control of annual grasses and small-seeded broadleaf weeds. Will not control emerged weeds so a tank-mix partner is generally necessary for initial control with Outlook providing residual grass control. Outlook can be tank-mixed with many other corn herbicides to broaden the spectrum of control and to increase the length of residual. Check label for common PRE and POST tank mix recommendations.

**Remarks:** 3 oz/a Zidua = 4.9 fl oz Zidua SC. Sequential applications of Zidua can be made in the same year but do not apply more than a cumulative amount of 0.146 lb pyroxasulfone/a (*Zidua*: 2.75 oz/a; *Zidua SC*: 4.5 fl oz/a) per year on coarse soil. On all other soil textures, do not apply more than a cumulative amount of 0.266 lb pyroxasulfone/a (*Zidua*: 5.0 oz/a; *Zidua SC*: 8.25 fl oz/a). Can be applied with water or various fertilizer combinations; see label for fertilizer use details. Certain seed corn, popcorn, and sweet corn genetics may be more sensitive to Zidua than others, so check with your seed supplier for additional information.

**Table 2-4.** Forage, grazing, and grain harvest intervals for corn herbicides<sup>a</sup>

Product	Forage/grazing interval (days)	Grain harvest interval (days)
2,4-D Amine <sup>4</sup> , 2,4-D LV <sup>4</sup>	0	7
Accent Q	0	30
acetochlor + atrazine premix	60	0
Acuron	45	60
Acuron GT	45	45
Acuron Flexi	45	45
Anthem <sup>b</sup>	30-70	70
Anthem Maxx	30	70
Anthem ATZ	60	70
Armezon	45	45
Armezon PRO	45	45
Autumn Super 51 WDG	0	0
atrazine	60	60
Balance Flexx	0	0
Basagran	0	12
Basis Blend	30	30
Bicep Lite II Magnum	60	0
Brox 2EC <sup>c</sup>	0	30
Cadet	30-70	70
Callisto	45	45
Callisto Xtra	45	60
Capreno	0	45
Clarity <sup>d</sup>	0	0
Corvus	45	0
Diflexx/ Diflexx Duo	45	0
Dual II Magnum	30	0
Enlist One/Enlist Duo	30	0
Fierce EZ	0	0
Gramoxone SL 3.0	7	7
Halex GT	45	45
Harmony SG	30	30
Harness	0	0
Harness MAX	60	60
Hornet WDG	85	45
Impact	45	45
ImpactZ	60	60
Impact Core	45	45
Instigate	45	45
Katagon	45	70
Laudis	0	45

Product	Forage/grazing interval (days)	Grain harvest interval (days)
Liberty 280 SL	70	60
LexarEZ/Lumax EZ	45	60
Maverick	30	30
metribuzin	60	60
NorthStar <sup>e</sup>	60	30
Outlook	0	40
Permit/Sande <sup>a</sup>	0	30
Princep 4L	60	60
Prowl H2O	0	21
Python	85	85
Realm Q	70	45
Resicore/Resicore XL	60	45
Resolve Q	30	30
Resource	28	28
Restraint	21	45
Revulin Q	45	70
Roundup PowerMAX	7	7
Sharpen	0	80
Shieldex 400SC	21	45
Sinate	60	70
Stalwart C	30	0
Stalwart Xtra Lite	60	0
Stalwart 3W	45	60
Status	72	32
Steadfast Q	0	30
Stinger	0	40
Storen	45	45
SureStart II	85	0
Surpass NXT	0	0
Tripleflex II	85	0
TriVolt	45	0
Valor SX	0	0
Verdict	80	0
Yukon	0	30
Zidua/Zidua SC	0	0

<sup>a</sup> Labels may have changed after this table was prepared. Consult current labels to verify the information.

<sup>b</sup> Do not harvest or feed sweet corn forage or ears for 40 days or fodder for any type of corn for 70 days after the last application.

<sup>c</sup> Can harvest grain if applied before tassel emergence.

<sup>d</sup> Delay harvest of forage until milk stage.

<sup>e</sup> Corn silage has a 45-day harvest interval.

**Table 2-5.** Rate equivalents of corn herbicide premixes

Herbicide	Rate/a	Provides the equivalent of:
acetochlor + atrazine Premix 5.6L	2.3 qt	2 pt Harness 7.0EC + 2.88 pt Atrazine 4L
acetochlor + atrazine Premix 6.0L	2.3 qt	2.8 pt Harness 7.0EC + 1.95 pt Atrazine 4L
Acuron	3 qt	1.5 pt Aatrex 4L + 27 fl oz Dual II Magnum 7.64EC + 5.76 fl oz Callisto 4L + 0.045 lb ai bicyclopyrone
Acuron GT	3.75 pt	27 fl oz Dual II Magnum 7.64EC + 3 fl oz Callisto 4L + 0.9 lb ae glyphosate + 0.045 lb ai bicyclopyrone
Acuron Flexi	2.25 qt	27 fl oz Dual II Magnum 7.64EC + 5.76 fl oz Callisto 4L + 0.045 lb ai bicyclopyrone
Anthem	10 fl oz	5 fl oz Zidua 4.17SC + 0.69 fl oz Cadet 0.91EC
Anthem Maxx	5 fl oz	10 fl oz Anthem
Anthem ATZ	32 fl oz	3.72 fl oz Zidua 4.17SC + 32 fl oz Atrazine 4L + 0.49 fl oz Cadet
Anthem Flex	6 fl oz	5.37 fl oz Zidua 4.17SC + 0.8 fl oz Aim 2L
Basis Blend 30DF	0.825 oz	0.66 oz Resolve 25DF + 0.17 oz Harmony SG
Bicep II Magnum 5.5L	1.9 qt	1.2 pt Dual II Magnum 7.64EC + 2.95 pt Aatrex 4L
Bicep Lite II Magnum 6L	1.5 qt	1.3 pt Dual II Magnum 7.64EC + 2 pt Aatrex 4L
Callisto Xtra 3.7CS	24 fl oz	3 fl oz Callisto 4L + 1.2 pt Aatrex 4L
Capreno 3.45L	3 fl oz	2.47 fl oz Laudis 3.5L + 0.013 lb thienencarbazone
Cinch ATZ	1.9 qt	1.2 pt Cinch 7.64EC + 2.95 pt Atrazine 4L
Cinch ATZ Lite	1.5 qt	1.3 pt Cinch 7.64EC + 2 pt Atrazine 4L
Corvus	5 fl oz	4.7 fl oz of Balance Flexx + 0.03 lb thienencarbazone
Degree XTRA 4.04CS	3.7 qt	2.85 pt Harness 7EC + 2.5 pt Atrazine 4L
Diflexx Duo	25 fl oz	7.88 fl oz Diflexx + 1.93 fl oz Laudis
Enlist Duo	4.75 pt	32 fl oz Enlist One 3.8L + 1.01 lb ae glyphosate
Fierce EZ	6 fl oz	2 oz Valor SX 51DF + 1.5 oz Zidua 85WG
FullTime NXT	3.7 qt	2.85 pt Harness 7EC + 2.5 pt Atrazine 4L
Halex GT	3.6 pt	1 pt Dual Magnum 7.64EC + 3 fl oz Callisto 4L + 0.9 lb ae glyphosate
Harness MAX	64 fl oz	2 pt Harness 7.0EC + 5.28 fl oz Callisto 4L
Hornet 68.5WDG	4 oz	0.93 oz Python 80WG + 5.3 oz Stinger 3SC
ImpactZ 4.26L	10.7 fl oz	1 fl oz Impact 2.8L + 0.65 pt Atrazine 4L
Impact Core	30 fl oz	0.76 fl oz Impact 2.8L + 1.9 pt Harness 7.0EC
Instigate 45.84WDG	6 oz	1 oz Resolve 25DF + 5 fl oz Callisto 4L
Katagon	3.4 fl oz	1 fl oz Shieldex 400SC + 0.76 oz Accent Q 54.5WDG
Lexar EZ 3.7 ZC	3.4 qt	1.6 pt Dual II Magnum 7.64EC + 6.1 fl oz Callisto 4L + 2.96 pt Aatrex 4L
Lumax EZ 3.7 ZC	3.25 qt	2.1 pt Dual II Magnum 7.64EC + 6.47 fl oz Callisto 4L + 1.5 pt Aatrex 4L
Maverick	1 qt	5.3 fl oz Zidua 4.17SC + 6.6 fl oz Callisto 4L + 7.4 fl oz Stinger 3SC
NorthStar 47.4WG	5 oz	0.5 oz Beacon 75WG + 4 fl oz Clarity 4SC
Realm Q	4 oz	1.2 oz Resolve 25 WDG + 2.5 fl oz Callisto 4L
Resicore	3 qt	2.4 pt Surpass NXT 7L + 7.2 fl oz Callisto 4L + 6.1 fl oz Stinger 3SC
Resicore XL	3 qt	2.4 pt Surpass NXT 7L + 6.5 fl oz Callisto 4L + 6.1 fl oz Stinger 3SC
Resolve Q	1.25 oz	0.92 oz Resolve 25WDG + 0.1 oz Harmony SG
Restraint	36 fl oz	1 fl oz Shieldex 400SC + 2 pt Harness 7.0EC
Revulin Q	4 oz	1 oz Accent Q 54.5WDG + 2.94 fl oz Callisto 4L
Sinate	28 fl oz	1 fl oz Impact 2.8L + 29.6 fl oz Liberty 2.34L
Stalwart Xtra Lite	2.1 qt	1.3 pt Stalwart C 7.8EC + 2.1 pt Atrazine 4L
Stalwart 3W	3.5 qt	1.5 pt Stalwart C 7.8EC + 6.1 fl oz Quartz 4L (mesotrione) + 2.9 pt Atrazine 4L
Status	5 oz	0.8 oz ae diflufenzopyr + 4 fl oz Clarity 4S
Steadfast Q 37.7WDG	1.5 oz	0.69 oz Accent Q 54.5WDG + 0.75 oz Resolve 25DF
Storen	2.4 qt	27 fl oz Dual II Magnum 7.64EC + 2.76 fl oz Zidua SC + 5.95 fl oz Callisto 4L + 0.045 lb ai bicyclopyrone
SureStart II/Tripleflex II	1.5 pt	0.8 pt Surpass NXT + 2.3 fl oz Stinger 3SC + 0.45 oz Python 80WG
TriVolt	20 fl oz	5.7 fl oz of Balance Flexx + 0.036 lb thienencarbazone + 0.445 lb flufenacet
Verdict 5.57EC	16 fl oz	3.2 fl oz Sharpen 2.86SC + 13.3 fl oz Outlook 6EC
Yukon 67.5WDG	4 oz	0.67 oz Permit 75WDG + 4 fl oz Clarity 4S

**Table 2-6.** Rainfree period and adjuvants required for postemergence corn herbicides

Herbicide	Corn Size/ Stage	Rainfast Interval (hours)	Recommended adjuvants				
			NIS	Crop oil concentrate		Nitrogen additive	
2,4-D Amine	0-8"	6-8	Do not add COC; add surfactant if directed by tank-mix partner.				
2,4-D LV4, Shredder <sup>a</sup>	0-8"	1	Do not add COC or serious corn injury may occur. Add surfactant if directed by tank-mix partner.				
Accent Q <sup>a</sup>	0-20" or V6	4	0.25%	or	1%	plus	28% N at 2 qt/a or AMS at 2 lb/a
acetochlor	0-11"	—	Add as directed by tank-mix partner. Does not control emerged weeds alone.				
acetochlor + atrazine premix	0-11"	—	—				
Acuron	0-12"	—	0.25%	or	1%		
Acuron GT	0-30" or V8	—	0.25%			plus	AMS 8.5-17 lb 100/gal
Acuron Flexi	0-30" or V8	—	0.25%	or	1%		
Anthem/Anthem Maxx	V4	1	0.25%	or	1-2 pt	plus	28% N at 1-2 qt/a or AMS at 2-3 lb/a
Anthem ATZ	V4	1	0.25%	or	1-2 pt	plus	28% N at 1-2 qt/a or AMS at 2-3 lb/a
Armezon	V8	1	—		1.0-1.5% (MSO preferred)	plus	28% N at 1.25-2.5% or AMS at 8.5-17 lb/100 gal
Armezon PRO <sup>a</sup>	0-12" or V8	1	—		0.5-1% (MSO preferred)	plus	28% N at 1.25-2.5% or AMS at 8.5-17 lb/100 gal
atrazine	0-12"	4	—		1 qt/a		
Balance Flexx	VE-V2	—	Do not use adjuvants				
Basagran <sup>b</sup>	NR	4	—		1 qt/a	or	28% N at 2-4 qt/a or AMS at 2.5 lb/a
Basis Blend	V2	4	0.25%	or	1%	plus	28% N at 2 qt/a or AMS at 2 lb/a
Bicep Lite II Magnum <sup>a</sup>	0-5"	—	Add as directed by tank-mix partner. Does not control emerged weeds alone.				
Brox 2EC	before tassel	1	Add as directed by tank-mix partner				
Cadet	0-48"	4	0.25%	or	1-2 pt/a	plus	28% N at 1-2 qt/a or AMS at 1-2 lb/a
Callisto/mesotrione 4L	0-30" or V8	1	—		1%	plus	28% N at 2.5% or AMS at 8.5 lb/100 gal
Callisto Xtra	0-12"	—	0.25%	or	1%	plus	28% UAN at 2.5% or AMS at 8.5 lb/100 gal
Caprenoa	V1-V6	1	—		1%	plus	28% N at 1.5 qt/a or AMS at 1.5 lb/a
Corvus	VE-V2	—	Do not use adjuvants				
dicamba <sup>a</sup>	0-8" or V5	4-8	—				
DiFlexx	VE-V10	4	0.25%	or	1% or MSO	plus	28% N at 2-4 qt/a or AMS 1.25-2.5 lbs/a
Diflexx Duo <sup>a</sup>	VE-V6	4		or	1% or MSO	plus	28% N a 1.5 qt/a or AMS 8.5-17 lbs/100 gal
Dual II Magnum/ Stalwart C	0-40"	—	Add as directed by tank-mix partner. Does not control emerged weeds alone.				
Enlist One/Enlist Duo <sup>a</sup>	0-30" or V8	—	See Enlist website for adjuvant information				
glufosinate <sup>a</sup>	0-24" or V7	4	—				Add AMS at 1.5-3 lb/a
glyphosate	0-30" or V8	2-6	Check label to see if surfactant is needed.				Add AMS at 8.5-17 lb/100 gal
Halex GT	0-30" or V8	—	0.25-0.5%			plus	AMS at 8.5-17 lb/100 gal

Continued on next page

**Table 2-6.** Rainfree period and adjuvants required for postemergence corn herbicides (continued)

Herbicide	Corn Size/ Stage	Rainfast Interval (hours)	Recommended adjuvants				
			NIS		Crop oil concentrate		Nitrogen additive
Harmony SG	V1-V5 or 16"	4	0.25%	or	1%	plus	28% N at 2–4 qt/a or AMS at 2–4 lb/a
Harness MAX	0-11"	1	0.25%	or	1%		
Hornet WDG <sup>a</sup>	0-20" or V6	2	0.25%	or	1%		Add 28% N at 2.5% if droughty
Impact	V8	1	—		1.0–1.5% (MSO preferred)	plus	28% N at 1.25–2.5% or AMS at 8.5–17 lb/100 gal
ImpactZ	0-12"	4	—		1.0–1.5% (MSO preferred)	plus	28% N at 1.25–2.5% or AMS at 8.5–17 lb/100 gal
Impact Core	0-11"	1			0.25-0.5% (MSO preferred)	plus	UAN at 1.25-2.5% or AMS at 1.5-2.5 lb/a
Instigate	VE-V2	1	0.25%	or	1%	plus	28% N at 2 qt/a or AMS at 2 lb/a
Laudis	V8	1	—		1% (MSO preferred)	plus	28% N at 1.5 qt/a or AMS at 8.5 lb/100 gal
Lumax EZ/Lexar EZ/ Stalwart 3W	0-12"	4	0.25%	or	1%		
Maverick	0-18" or V6	6	0.25%	or	1%		AMS should only be added in tank mixes with glyphosate or glufosinate
metribuzin	VE-BT	—	0.25%			plus	28% N at 0.5-1 gal/a or AMS at 17 lb/100 gal
NorthStar <sup>a</sup>	4-20"	4	0.25%	or	1-4 pt/a if corn < 12"		28% N at 2–4 qt/a or AMS at 2–4 lb/a
Outlook	0-12"	—	Add as directed by tank-mix partner. Does not control emerged weeds alone.				
Katagon	0-20" or V5	4	0.25%	or	0.5-1% MSO preferred	plus	UAN/Liquid AMS at 2.5% v/v or AMS at 8.5 lb/100 gal
Permit/Sandea <sup>a</sup>	0-36"	4	0.25–0.5%	or	1%		28% N at 2–4 qt/a or AMS at 2–4 lb/a may be added if required by tank-mix partner
Prowl H2O	0-30" or V8	—	Add as directed by tank-mix partner. Does not control emerged weeds alone.				
Python WDG	0-20" or V6	6	0.25%	or	1%	plus	28% N at 2.5% v/v or AMS at 2-4 lb/a
Realm Q	0-20" or V6	—	0.25%	or	1%	plus	28% N at 2 qt/a or AMS at 2 lb/a
Resicore	0-11"	—	0.25%	or	1%		AMS should only be added in tank mixes with glyphosate or glufosinate
Resicore XL	0-24"	—	0.25%	or	1%		AMS should only be added in tank mixes with glyphosate or glufosinate
Resolve Q	0-20" or V6	4	0.25%			plus	28% N at 2 qt/a or AMS at 2 lb/a
Resource	V2-V10	1	—		1 pt/a	—	—
Restraint	0-20" or V6	1	0.25%	or	1%		
Revulin Q <sup>a</sup>	0-20" or V6	—	0.5%(HSOC)		1%	plus	2 lbs/a of AMS or UAN
Shieldex 400SC	0-20" or V6	1	0.25%	or	0.5-1% MSO preferred	plus	UAN/Liquid AMS at 2.5% v/v or AMS at 8.5 lb/100 gal
Sinate	0-24" or V7	4	0.5-0.75% (HSMOC)	or	1% (MSO preferred)	plus	AMS at 3 lb/a

Continued on next page

**Table 2-6.** Rainfree period and adjuvants required for postemergence corn herbicides (continued)

Herbicide	Corn Size/ Stage	Rainfast Interval (hours)	Recommended adjuvants				
			NIS	Crop oil concentrate		Nitrogen additive	
Statusa	4-36" or V2-V8	4	0.25%	or	1%	plus	28% N at 1.25% or AMS at 5-17 lb/100 gal
Steadfast Q	0-20" or V6	4	0.25%	or	1%	plus	28% N at 2 qt/a or AMS at 2 lb/a
Stinger	0-24"	6-8	Adjuvants not required.				
Storen	V8	—	0.25%			plus	AMS at 8.5-17 lb/100 gal
SureStart II/Tripleflex II	0-11"	—	Add as directed by tank-mix partner. Limited activity on emerged weeds.				
TriVolt	VE-V2	—	Do not use adjuvants.				
Yukon <sup>a</sup>	0-20"	4	0.25-0.5%	or	1%		28% N at 2-4 qt/a or AMS at 2-4 lb/a may be added if required by tank-mix partner
Zidua/Zidua SC	VE-V4	—	Add as directed by tank-mix partner. Does not control emerged weeds alone.				

Abbreviations: AMS = ammonium sulfate; BT = before tassel; COC = crop oil concentrate; HSMOC = high surfactant methylated oil concentrate; MSO = methylated seed oil; N = nitrogen; NR = no restrictions; UAN = urea-ammonium nitrate <sup>a</sup>Drop nozzles allow these herbicides to be applied after stages listed in table: 2,4-D before tasseling; Accent Q up to 36" or V10; Armezon PRO up to 30"; Bicep Lite II Magnum up to 12"; Capreno up to V7; DiFlexx Duo up to 36" or V10; Enlist up to 48"; Revulin Q up to 30" or V8; dicamba, glufosinate, Hornet WDG, NorthStar, Status, and Yukon up to 36". <sup>b</sup>Add COC for lambsquarters and common ragweed control, a nitrogen additive for velvetleaf control, or both if all three weeds are present.

# Corn insect management

Insecticides suggested in this section are intended as a guide to assist you in selecting chemical control options. While suggestions provide an overview of product registrations for specific field crop insect pests, this guide is not intended as an exhaustive insecticide label source. Product inclusion or omission does not imply endorsement by the University of Wisconsin-Extension. Keep in mind that insecticide active ingredients are produced by more than one manufacturer. Directions for use, rate, and method of application may vary by formulation. Therefore, always read the insecticide label completely before using the material.

Several of the products listed in this section are restricted-use insecticides. We discuss restricted-use pesticides at the beginning of this publication. Refer to appendix table 7-2 for a list of insecticides that currently require certification to be applied. It is possible that additional insecticides will be classified before the next growing season. Contact your county Extension Educator for additional information on insecticide restrictions.

Common and trade names of insecticides are often used interchangeably. Trade names such as Warrior II are capitalized, while common chemical names, lambda cyhalothrin in this example, are not.

As of this publication date, EPA has revoked all tolerances for the use of chlorpyrifos in feed and food crops effective February 28, 2022. All insecticides containing this active ingredient have been removed from this list.

## Chemigation

Some insecticides can be applied through certain sprinkler irrigation systems, as specified on the label, for control of various aboveground corn insect pests. Consult product labels for specific instructions. Wisconsin has

stringent regulations regarding the application of pesticides through irrigation water, and an approved anti-siphon system is required. Contact the Wisconsin DATCP for information on legal requirements.

## Predicting soil insect control needs for corn

Crop rotation patterns significantly influence the occurrence and extent of soil insect problems in corn. Awareness of these relationships, along with field scouting information, can help predict the need for a planting-time application of a soil insecticide, a seed-applied insecticide, or selection of a Bt corn hybrid. Exceptions occasionally can occur because of weather fluctuations, abundance or lack of natural enemies, tillage, etc. The following are guidelines for predicting soil insect problems in corn and selecting insect pest management tactics accordingly.

### Continuous corn

Corn rootworm is known as a continuous corn pest because it requires corn roots to complete development. Rootworms cause damage beginning the second year when overwintering eggs hatch and larvae feed on corn roots to complete development. (Larvae that emerge in fields planted to non-host crops such as alfalfa or soybean will not complete their development.) A corn rootworm control strategy may be necessary at planting time on continuous corn grown in the rootworm area of the state. For more details about rootworms and control options, see the discussion under **Insect Pests**.

### Corn after soybeans

The incidence of soil insect problems in corn following soybeans is typically low, and the use of a commercial seed treatment for control of soil-dwelling

secondary insect pests (e.g., seed-corn maggot, wireworm, white grub) will normally be sufficient. Check seed-applied insecticide labels for pests controlled and/or suppressed. Soil-applied insecticides are seldom necessary.

In most of the state, corn rootworm damage is not a problem when corn is rotated annually with soybeans or other crops, as the adult beetles primarily lay their eggs in cornfields. Larvae that hatch in fields other than corn will starve to death. This makes crop rotation a highly reliable cultural control method.

In some cases, not all northern corn rootworm eggs will hatch after the first winter. Some northern corn rootworm eggs remain in a dormant state for two or more winters before hatching. This behavior, known as extended diapause, is more prevalent in states west of Wisconsin. In a 3-year successive rotation of corn/soybean/corn, this can result in economic rootworm injury during the year that corn follows soybean. Therefore, damage to corn that follows soybean in rotation does not necessarily mean that rootworm beetles laid eggs in soybean. Additionally, corn rootworm beetles present in cornfields that follow soybean, alfalfa, or another crop in rotation did not necessarily emerge from the soil in those fields. Rootworm beetles are mobile and are capable of dispersing to new fields very soon after emergence. For areas not affected by the variant western corn rootworm (see next section), if beetles are present in cornfields that follow a crop other than corn, they are likely migrants and did not emerge in such fields.

Although rootworm beetles can be found in "clean" soybean fields, they are especially attracted to weedy fields or those that contain volunteer corn. In these cases, rootworm beetles

may deposit enough eggs in soybean fields to cause economic damage when corn is planted the following year. Control of grassy weeds and volunteer corn will help reduce potential problems from corn rootworm as well as larval wireworm, white grub, stalk borer, hop vine borer, and potato stem borer the following year, since the weeds can be attractive to egg-laying adults during the summer.

### Corn after soybeans: Rotation resistant (variant) western corn rootworm

A variant strain of the western corn rootworm, now commonly called the rotation resistant western corn rootworm, has developed a behavioral adaptation to the corn-soybean rotation in some areas of the Midwest, including parts of Wisconsin. This strain no longer requires corn as an egg-laying site. Like normal western corn rootworm beetle populations, this variant moves readily between corn and other crops. Unlike normal rootworm beetles, this variant can lay heavy populations of eggs in soybean fields, resulting in economic injury to corn planted the following year.

The variant western corn rootworm (variant WCR) has been documented in southern Wisconsin, the northern two thirds of Illinois, much of Indiana, southern Michigan, and western Ohio. A team of UW-Extension researchers, corn-soybean growers, and Wisconsin DATCP specialists confirmed its presence in Kenosha, Racine, Walworth, and Rock counties. However, recently there has been little if any concern to first year corn. Contact your UW-Extension educator for the most current information on variant WCR in your area.

In affected areas, producers and consultants should take steps to minimize the risk of corn rootworm damage to first-year corn following soybeans. It's important to scout to determine whether the variant WCR is present in sufficient numbers to cause economic damage. Treating first-year corn without first establishing the need is both costly and environmentally unsound.

Unbaited yellow sticky traps, available from Gempler's and Great Lakes IPM, are used to monitor beetle abundance in soybeans and predict the need for at-planting corn rootworm treatment the following year. For assistance implementing a scouting program, contact your county Extension agent.

If you determine that control is needed, there are several options for reducing damage the following year:

- Use a granular or liquid soil insecticide at planting.
- Plant a Bt rootworm corn hybrid.
- Plant corn treated with a corn rootworm-rate insecticidal seed treatment.

### Corn after sod

True grass sod, including grassy legume fields, may harbor pests such as white grubs, wireworms, cutworms, sod webworms, and grasshoppers. Species of wireworms and white grubs that take longer than 1 year to develop also may be a problem in the second and third years if not controlled in the first year. Seedcorn maggot flies also may be attracted to the increased organic matter of a grass sod broken for corn planting.

Insecticidal seed treatments will control seedcorn maggots, but soil insecticide treatments may be needed for pests like wireworms and white grubs. Several soil insecticides labeled for corn rootworm control are also labeled for control of wireworms and white grubs. In addition, low-rate nicotinic insecticidal seed treatments are labeled for wireworms and white grubs.

Minimum tillage of true grass sods is favorable to such corn insect pests as cutworms, armyworms, grasshoppers, and stalk borers.

### Corn after alfalfa

Rootworms occasionally can be a problem in corn following alfalfa, but this is far less common than damage to corn planted after soybean. Adult

rootworm beetles attracted to alfalfa or weed blossoms during the summer egg-laying period occasionally have laid enough eggs to cause economic damage the following summer.

There also is a potential for damage from wireworms and white grubs when corn follows grassy alfalfa and clover fields.

Some insecticides are labeled for preventative treatment for occasional pests such as black cutworm, early-season armyworm, and stalk borer, particularly when corn is no-till planted into sod. However, because of the erratic occurrence of these pests, scouting of seedling corn plants combined with timely insecticide application at insect pest thresholds is a more cost-effective and environmentally sound approach. Your county Extension educator can assist you in developing a scouting program.

## Insect pests

### Armyworm

The true armyworm causes serious damage in some areas of the state almost every year. Armyworms will climb into corn whorls or even attack tasseled corn and "rag" the leaves from the outside edges toward the midrib, sometimes leaving only midribs on the stalk or eventually eating the stalks to the ground. Defoliation below the ear zone is not as detrimental as leaf feeding above the ear.

Armyworms do not overwinter in Wisconsin. The adult moth migrates to the state on storm fronts each spring. Therefore, the arrival of this flight varies each year. Concentrate scouting activities in seedling cornfields that have a significant grassy weed population and/or are no-tilled into an alfalfa field or planted into grassy cover crops such as cereal rye.

The summer generation of armyworm moths will lay eggs on weedy grasses in cornfields; thus, grass weed control in corn is important. If a cornfield has a heavy infestation of grassy weeds, scout the field carefully. Look on the

ground, under debris, and on the weeds.

“Weed-free” fields will not guarantee immunity from armyworm attacks. The armyworm can also migrate into corn from nearby harvested alfalfa, pea, or small grain fields, or other grassy areas. Monitoring these kinds of fields when they border corn is necessary. When the armyworm migrates into corn from adjoining areas, only a few border rows may need treatment if infestation is detected early enough.

If you find signs of armyworm feeding, check five sets of 20 plants at random. Record the number of damaged plants and the number of worms per plant. Spot treat, if possible when you find two or more armyworms (0.75–1.0 inch or smaller) per plant on 25% of the plants or one per plant on 75% of the plants. Finding the worms while they are still small and before damage to corn is severe increases the value of control. Young worms also are easier to control than those nearing maturity.

### Corn earworm

Hybrid seed corn production fields occasionally need protection from corn earworm. Moths lay eggs on green and yellow color-stage silks, and larvae crawl down the silk channel and feed on kernels. Corn earworm larvae can be confused with European corn borer or western bean cutworm larvae, which also feed within the ears.

Pheromone traps can be used to trap male moths and monitor population trends. Treat with an insecticide (see table 2-9) at 10% silk if traps capture 5–10 male moths/night. A second application may be needed 7–10 days later if traps continue to catch 5–10 moths per night.

### Corn flea beetle

As the name implies, corn flea beetles are small ( $\frac{1}{16}$  inch) and will leap great distances when disturbed. These black beetles overwinter in clumps of grass near cornfields and move to corn seedlings shortly after they emerge in the spring. Feeding damage appears

as long, thin, silvery-white streaks. Although heavily injured leaves turn brown and wilt, beetle populations in Wisconsin are rarely large enough to cause this type of damage. The corn flea beetle is more important for its role in transmitting a bacterial disease known as Stewart’s wilt or Stewart’s disease. This disease is an occasional problem in Wisconsin. Beetles can spread the bacterium *Erwinia stewartii* during feeding. The bacterium can overwinter within the beetle, on plant debris, or in the soil. For more information about Stewart’s wilt, see the **Corn Diseases** section.

Sweet corn and inbred corn can be highly susceptible to Stewart’s wilt and should be scouted from seedling emergence to the V-5 stage. An insecticide may be warranted if there are two to three beetles per plant and if 10% of the plants exhibit feeding injury.

Flea beetle survival and Stewart’s wilt potential are predicted using the average monthly temperatures for December, January, and February. Typically, Stewart’s wilt causes significant losses only one or two years in a 20-year period. For flea beetle predictions, consult early spring issues of the UW, Division of Extension Wisconsin Crop Manager newsletter ([ipcm.wisc.edu/wcm](http://ipcm.wisc.edu/wcm)).

### Corn leaf aphid

Corn leaf aphids are greenish blue, soft-bodied, and about the size of a pinhead. Their sap-sucking stresses plants and interferes with ear production. Soil moisture stress reduces the plant’s ability to withstand attack. Moisture stress and heavy infestations (tassel and upper leaves plastered with aphids) can result in barren plants.

The most critical period for damage is the late-whorl to pollen-shed stages. If aphid populations are high by the time corn has tasseled and pollinated, major damage will already be done. Because of this, begin scouting fields approximately 2–3 weeks before tassel emergence. (You will have to pull

and unroll whorl leaves to do this.) Treatment is suggested if 50% of the plants have more than 50 aphids per plant, and plants are in the late-whorl to early tassel stages.

Apply sprays before the tassels have completely emerged but not before the upper whorl leaves have opened to expose the tassels. Remember that the presence of predators and adequate soil moisture can influence treatment decisions.

### Corn rootworm

Northern and western corn rootworms overwinter as eggs in the soil. Larvae usually can be found feeding on developing corn roots by mid-June, peaking by mid-July. After completing three larval stages, larvae will cease feeding on the roots and pupate in the soil. The pupae change into adults that exit the soil to feed on pollen, silks, and in the case of the western corn rootworm, even tender foliage. At Arlington, Wisconsin, the first adults normally begin to appear in early July. Because of the prolonged egg hatch, all stages (larvae, pupae, and adults) can be found in July and August. Most of the eggs will be laid from mid- to late August.

The potential for damage and the need for a rootworm control strategy in fields of corn that follow corn are based on the number of beetles present in fields during the summer egg-laying period. If beetle numbers averaged 0.75 or more per plant during August, the use of a corn rootworm control tactic (soil insecticide, seed treatment, or Bt corn rootworm hybrid) is recommended if corn is planted again in the field the following year. Consult UW-Extension publication [IPM Decision Aid: Managing Corn Rootworm Bt Resistance for more information](#) about scouting cornfields for rootworm beetles and about predicting the need for rootworm control.

Rootworm are controlled by crop rotation. Where cropping systems allow and where the variant (rotation resistant) western corn rootworm is not established, crop rotation is an

excellent method of controlling corn rootworm. Larvae will perish soon after hatching if a crop other than corn is planted. Resistance to insecticides and Bt proteins is possible whenever a population of insects is subjected continually to selection pressure from one insecticide class. To prevent resistance and lower rootworm populations, we strongly encourage the use of crop rotation as a control alternative for corn rootworm.

Late-planted cornfields are attractive to rootworm beetles. The corn's green silks and fresh pollen can attract large numbers of beetles from surrounding fields and result in a large number of eggs being deposited in the soil. Since soil insecticides and Bt hybrids will not control all the rootworm larvae, an unacceptable amount of root feeding could still occur in fields with heavy egg populations. In these cases, crop rotation is a better alternative when possible.

#### Rotation resistant corn rootworms.

In the south/southeast area of Wisconsin, western corn rootworm beetles have adapted to a corn/soybean rotation and have been known to lay eggs in soybean fields. However, in recent years, the report of this phenomenon have been infrequent. For fields in this area of Wisconsin, use the yellow sticky trap method to determine damage potential in corn planted after soybean. In some mid-western states (other than Wisconsin), Northern corn rootworms have adjusted to a corn/soybean rotation through the adoption of a two-year life cycle called extended diapause. This phenomenon requires two winter chilling periods before eggs hatch. Extended diapause has not been confirmed in Wisconsin but may happen on rare occasions.

#### Insecticidal control of rootworms.

Although a soil insecticide will not kill all corn rootworms in a field, the level of control achieved normally is adequate to prevent economic damage. However, extremely high larval populations, heavy rains, improper calibra-

tion and/or incorporation, and other factors can result in poor control.

The following are suggestions for using rootworm insecticides.

- **At planting:** Apply a granular or liquid insecticide labeled for rootworm control as an in-furrow or banded application at the labeled rate (Table 2-7). Refer to product label for instructions.
- **Control of rootworm beetles to prevent egg laying:** Properly timed foliar applied insecticide applications may reduce beetle populations during the egg laying period. However, this practice is not suggested as a primary larval control practice that eliminates the need for soil insecticides the following year to protect corn roots. Its utility may be when adult beetle numbers are excessively high and there is concern that Bt hybrids and soil-applied insecticides may not adequately control larval feeding in continuous corn. These situations are rare in Wisconsin. Success using this program requires frequent and careful scouting. Scouts must determine the sex of the beetles and tell when the females are gravid (contain eggs).

Treatments include several foliar-applied insecticides. These insecticides are hazardous to honeybees. Do not apply or allow product to drift onto blooming crops and/or blooming weeds if bees are foraging the area to be treated. Notify local beekeepers when using such programs.

Single application treatments for beetle control are not always sufficient due to beetle migration and weather conditions.

- **Use of soil applied insecticides with Bt Traits:** This practice has merit only when extremely high beetle counts were observed the previous year. You should expect either your Bt trait or soil applied insecticide to perform adequately under normal beetle populations. The combination of a soil applied

insecticide and Bt hybrid is not recommended as a resistance management tool.

- **Alternating the use of insecticide active ingredients:** Avoid using the same insecticide for several consecutive years. Continuous use of the same class of material, uninterrupted by crop rotation, or periodic rotation of insecticide class can lead to the development of insect resistance and loss of product efficacy.
  - If the material you used last year performed poorly, switch to another insecticide class this year or rotate to a crop other than corn if possible.
  - Avoid using the same organophosphate or pyrethroid during consecutive years.

**Insecticidal seed treatment for rootworm control.** Seed treatment with insecticides from the nicotinoid class of compounds are labeled for corn rootworm. These compounds are systemic, translocated within the plant as the seed germinates and as the plant grows. This is a selective, early-season chemical control tactic as the active ingredient is applied directly to the seed and not the surrounding soil.

Cruiser Extreme 1250 (thiamethoxam) and Poncho 1250 (clothianidin) are labeled at 1.25 mg ai/kernel for corn rootworm. Corn seed is treated by commercial seed treaters in conjunction with seed dealers before it is bagged and sold. Check with your seed dealer to obtain corn seed treated at the rate labeled for corn rootworm.

#### Bt corn for corn rootworm control.

Transgenic Bt corn contains a gene from the soil bacterium *Bacillus thuringiensis* (Bt) enabling the plant to express Bt toxin active against rootworms. For details, see the section on **Transgenic Bt Corn**.

## Cutworm

Although glassy and sandhill cutworms can cause serious damage, the most common cutworm pest in Wisconsin corn is the black cutworm. Young cutworms feed upon corn foliage; early detection of this injury allows time to treat before extensive cutting occurs. For this reason, monitor fields carefully as plants emerge. Check for signs of leaf feeding, cut, wilting, or missing plants. Leaf feeding is due to small cutworms (less than 0.5 inches long); cutworms start to cut plants when they reach the fourth instar.

It is difficult to set a threshold for treatment because several factors influence this decision (stage of plant growth, original plant population, growth stage of cutworms, soil moisture, etc.). The most important aspect of cutworm control is careful field scouting as soon as plants begin to emerge. Remember that there have been instances of cutworms cutting plants as fast as they emerge.

Carefully monitor corn especially low wet areas within fields, late-planted fields, and fields with low-growing winter annual broadleaf weeds, where cutworm problems tend to be most common. Marking off defined areas of a field makes it easier to evaluate the cutworm situation. Check these areas every 2-3 days for at least 2-3 weeks after corn begins to emerge. Keep records of plant stand, number of cut plants, and plants with leaf feeding. This helps evaluate whether populations are increasing or decreasing. If you find occasional cut plants, consider corrective measures. One cutworm is capable of cutting several plants, and the level of damage can increase dramatically from one day to the next. Consult Table 2-7 for assistance in determining how long a cutworm will feed and continue to damage corn. For example, a fourth instar (stage) cutworm (larva) will feed for approximately 25 days and will cut off four plants if the plants are in the 1-leaf stage.

Body length is not always an accurate indicator of how "old" a cutworm is. The best technique is to measure the width of the insect's head capsule. Place the head capsule (head) of the cutworm between the shaded areas under the head capsule width column in Table 2-7 and match it to one of the size categories available. This will help you determine the age of the cutworm and approximately how long it will continue to feed on corn.

Treatment is suggested when 2-5% of the plants have been cut. Broadcast foliar insecticide when the suggested threshold is reached. Rescue treatments can be very effective for black cutworms if infestations are found soon enough. However, hot, dry weather can reduce the effectiveness of these treatments by causing the black cutworm to spend more time underground, thereby reducing exposure to the insecticide.

If widespread cutworm damage necessitates replanting, you may need to use preemergence rescue treatments. Depending on cutworm size when corn is replanted, feeding injury could occur before, during, and after seedling emergence. In these situations, treating fields after planting but before seedling emergence may be advisable.





Soil insecticides, such as Aztec, Brigade 2EC and Force, are labeled for application at planting time for cutworm control. These products should be applied the same as for rootworm control (refer to Table 2-7). Current research suggests that some of these products are relatively effective in controlling light to moderate infestations

when applied at planting. However, data for heavy infestations are limited, and reports of unacceptable levels of damage from heavy infestations have occurred. Because of these factors and the difficulty of predicting cutworm outbreaks, the "preventive approach" to black cutworm control is not suggested. Field scouting and rescue treatment is more reliable.

## European corn borer

The European corn borer has two generations per year in most of Wisconsin. Borers overwinter as 5<sup>th</sup> instar larvae in cornstalks and large-stemmed weeds. Moths emerge to begin warm-night egg laying on undersides of leaves about mid-June (in the extreme south of the state). Eggs hatch into very small, black-headed, whitish, smooth larvae (borers) that crawl into the whorl. Early planted corn is most apt to be infested. Late-planted corn usually avoids first-generation borers but is attractive to the second generation. "Early" borer leaf feeding shows as irregular pinhole damage in leaves growing out of the whorl. "Recent" leaf feeding can be found down in the whorl and is evidence of live borers. Once corn reaches 18 inches of extended leaf height, examine 10 consecutive plants in 10 areas of the field for leaf feeding. Pull the whorl leaves from two infested plants in each area and unroll the leaves to look for corn borer larvae. Calculate the percentage of plants with recent leaf feeding ("plants infested") and the average number of European corn borer larvae per infested plant. Consult the Management worksheet

**Table 2-7.** Guide to black cutworm development and damage in corn

Larval instar (stage)	Head capsule width	Approximate days left to feed	Potential number of plants that may be cut		
			1-leaf	2-leaf	4-leaf
4		25	4	3	1
5		21	4	3	1
6		14	4	3	1
7		5	1	1	1

for first-generation corn borer (above) to determine whether treatment is necessary.

The best time to control first-generation corn borers is during a period of 800-1,100 accumulated, modified growing degree-days (above 50°F average). In extreme southern Wisconsin, this falls around July 1-4.

Second-generation European corn borer egg-laying occurs over a long period of time, and infestations can go unnoticed until ears begin to drop, and stalks begin to break in the fall. Due to the extended egg-laying period, one sampling of a field is not sufficient. Scout fields weekly looking for white egg masses on the undersides of leaves near the midrib. Most of the eggs will be laid on leaves near the ear and above. Use the Management worksheet for second-generation corn borers (see above) to determine whether treatment will be economically worthwhile. If possible, treat when tiny black dots are apparent on most of the egg masses. At this "black-head" stage, the eggs are almost ready to hatch.

Most borers are killed when corn is cut for silage or shredded for fodder if stubble is under 2 inches. Dry-stalk shredding may kill 80% of the borers. Plowing under crop stubble and shredding stalks in the fall to destroy overwintering larvae will reduce corn borer populations. However, mold-board plowing is often unacceptable because of the potential for soil erosion.

### Bt corn for European corn borer control.

Transgenic Bt corn contains a gene from the soil bacterium *Bacillus thuringiensis* (Bt) enabling the plant to express Bt toxin active against European corn borers.

### Japanese beetle

Japanese beetle adults are about ½ inches long and ⅜ inches wide, with metallic, copper-colored wing covers and a green thorax and head. Adults emerge in mid-June, feed on a wide range of host plants and can move to

field and sweet corn. The most significant damage comes when Japanese beetles feed on corn silks during pollination.

During July and August, adults move to grass and turf to lay eggs. They can also lay eggs in soybean fields and to a lesser extent, cornfields. Eggs hatch into small white grubs that feed on grass roots until fall temperatures cool. Third instar grubs move down in the soil profile and are inactive during winter. In early spring, grubs feed, pupate, and then emerge from the soil as adult beetles in late June.

Consider a foliar insecticide treatment during tasseling and silking if there are three or more beetles per ear, silks have been clipped to less than 0.5 inch, and pollination is less than 50% complete. Obtain a representative field sample to determine whether field border treatment is sufficient or whole field treatment is necessary. Adults are highly mobile during July and August. Beetles present in the field when treated with a foliar insecticide will be killed, but beetles moving into treated fields after application can result in reinfestation.

As one of several species of white grubs, Japanese beetle larvae are an occasional pest of corn roots in corn following sod, set-aside, some cover crops, or soybean.

### Slugs

"Slug" is a common name given to a group of terrestrial organisms in the phylum Mollusca. Typically, they are referred to as "snails without a shell". Slugs are soft-bodied, legless, slimy and may be light to dark colored. Most slugs are herbivorous and will feed on a variety of broadleaf and grass plants including corn and soybean. Feeding may be of economic importance under no-till conditions and/or high weed pressure. Slugs may be found in small grains and alfalfa, however, rarely are they of economic importance.

Life stages may not always be synchronized, allowing for various life stages to be present at the same time. It is possible for slugs to overwinter as adults, juveniles and eggs. However, in cold winters without snow cover, eggs offer the best chance of survival.

#### Management worksheet for FIRST-GENERATION European corn borer

\_\_\_\_\_ % of 100 plants infested x \_\_\_\_\_ ave. # borers/infested plant<sup>a</sup> = \_\_\_\_\_ borers/plant  
 \_\_\_\_\_ borers/plant x 5% yield loss/borer = \_\_\_\_\_ % yield loss  
 \_\_\_\_\_ % yield loss x \_\_\_\_\_ expected yield (bu/a) = \_\_\_\_\_ bu/a loss  
 \_\_\_\_\_ bu/a loss x \$ \_\_\_\_\_ price/bu = \$ \_\_\_\_\_ loss/a  
 \$ \_\_\_\_\_ loss/a x \_\_\_\_\_ % control<sup>b</sup> = \$ \_\_\_\_\_ preventable loss/a  
 \$ \_\_\_\_\_ preventable loss/a - \$ \_\_\_\_\_ cost of control/a  
 = \$ \_\_\_\_\_ gain (+) or loss (-) per acre if treatment is applied

<sup>a</sup> Determined by checking whorls from 10 plants.

<sup>b</sup> Assume 80% control for most products; assume 50% control for Asana sprays.

#### Management worksheet for SECOND-GENERATION European corn borer

\_\_\_\_\_ number of egg masses/plant<sup>a</sup> x 2 borers/egg mass<sup>b</sup> = \_\_\_\_\_ borers/plant  
 \_\_\_\_\_ borers/plant x 4% loss/borer<sup>c</sup> = \_\_\_\_\_ % yield loss  
 \_\_\_\_\_ % yield loss x \_\_\_\_\_ expected yield = \_\_\_\_\_ bu/a loss  
 \_\_\_\_\_ bu/a loss x \$ \_\_\_\_\_ price/bu = \$ \_\_\_\_\_ loss/a  
 \$ \_\_\_\_\_ loss/a x 75% control = \$ \_\_\_\_\_ preventable loss/a  
 \$ \_\_\_\_\_ preventable loss/a - \$ \_\_\_\_\_ cost of control/a  
 = \$ \_\_\_\_\_ gain (+) or loss (-) per acre if treatment is applied

<sup>a</sup> Use cumulative counts, taken 7 days apart.

<sup>b</sup> Assumes a survival rate of two borers/egg mass.

<sup>c</sup> Use 3% loss/borer if infestation occurs after silks are brown. The potential economic benefits of treatment decline rapidly if infestations occur after corn reaches the blister stage.

al. Slug development, life cycle, and overwintering survival has not been well researched in Wisconsin.

Slugs have a “rasp-like” mouthpart called a radula and damage seedling corn plant by scraping off leaf tissue. These feeding scars are usually longitudinal and may initially leave the wax-like cuticle intact. This symptom is often called “window paining”. Eventually, the cuticle will weather and drop off leaving long, narrow holes in leaves.

Slugs feed nocturnally and occasionally on cool, cloudy days. During daylight hours they hide under soil clods and plant debris. Therefore, minimal till and no-till fields have the greatest possibility for damage.

Initiate scouting for slugs in field areas with a history of slug feeding. Look through debris for eggs, juveniles and/or adults in early spring when corn is emerging. Record the percentage of plants affected, degree of defoliation and identify those field areas where slug activity is present. Economic thresholds have not been established.

Reducing crop residue through primary or secondary tillage including row cleaners for strip-tillage can be effective. However, many growers with slug problems may be committed to reduced or no-tillage because of conservation plans. Early planting may give corn enough of an early start to be able to outgrow slug damage. Make sure the seed furrow is close during planting because slugs can feed on the growing point and kill corn. Slugs have several natural enemies including ground and rove beetles, centipedes, spiders, and several other invertebrate predators. Insecticides do not control slugs. Consider use of a bait if preventive measures are ineffective.

### Stalk borer

Stalk borer moths predominately lay their eggs on grass weeds during late summer and fall. In addition, giant ragweed is one of the few broadleaf

plants to serve as a preferred egg-laying host. Larvae will hatch from these hosts in the spring and move quickly to corn. The first indication of damage is a series of small pinhole feeding sites running across the leaves of V-1 corn. As the larvae grow, the feeding holes will increase in size, and the larvae will tunnel into the plant. This stem boring can be seen in the wilting of the central leaves of the seedling. When this type of injury is widespread, it is too late to apply an insecticide. Stalk borers tunnel only in the aboveground portions of the stem, whereas cutworms, hop vine borer, and potato stem borer feed in the underground portion of the stem.

Damage will often be heavy in the four to eight rows that are near fence-rows, grass terraces, and waterways. In these cases, the larvae are migrating from adjacent vegetation. Patches of injury throughout the field indicate significant levels of host weeds that escaped the weed control program from the previous year. The best insect management tactic is to modify your weed control program using a different herbicide, crop rotation, or increased mechanical cultivation to control these host weeds.

Small corn is most susceptible to injury; once plants reach the V-7 stage it is unlikely that they will be killed by stalk borers. Research suggests scouting border rows when 1,300-1,400 degree days (base 41°F) have occurred. Stalk borer movement from grassy areas within and adjacent to corn fields first occurs at about 1,110 degree days and peaks when about 1,650 degree days are accumulated. If an insecticide is needed, treat between 1,400-1,700 degree days.

Larvae will start to move when they have outgrown the grass stems in which they have been feeding. However, damage from larvae originating within the field (from the previous year's weed patches) will start earlier because corn is the only food source. Growers should map these spots during fall harvest and check them the following year, starting at about

900-1,000 degree days. For spray management decisions, consult Table 2-8.

### Two-spotted spider mite

Spider mites are relatives of insects and are so small that a 10X or greater magnification is required for them to be seen distinctly. They damage plants by piercing the cells and sucking sap. Small chlorotic lesions on the leaf surface are the first indications of damage. As mite populations build and damage progresses, the webbing produced by the mites will become apparent, and leaves may die. Plant death is possible if populations are heavy.

Mites are not a problem in Wisconsin unless dry weather persists. Infestations normally start at field edges where mites have migrated from adjacent weeds, alfalfa, or other vegetation. Control is suggested when the lower ¼ to ½ of the canopy is injured (live mites and leaf injury symptoms), and corn has not denting. Effects on corn yield are more severe when mites damage leaves at or above the ear level.

Insecticides applied for mite control will not kill eggs, and growers will have to sample the field 4-5 days after the initial spray and look for mite adults and nymphs. A second application may be necessary. Miticides labeled for corn may kill eggs. Read label for specific products.

Mites are usually on the undersides of plant leaves, making treatment difficult. By air, apply no less than 4-5 gallons of finished spray per acre. During periods of extreme heat, try to make applications late in the day to reduce the amount of insecticide lost by volatilization.

### Western bean cutworm

Western bean cutworm (WBCW) larvae feed on ears — damaging and consuming kernels. Secondary pathogens and mold are frequently associated with larval feeding in ears.

Unlike corn borers, they do not tunnel into stalks.

Adult WBCW are brown-colored moths, 0.75-inch long with an extended wingspan of 1.5 inches. There are three distinctive markings on each forewing: a white wing bar along the front leading edge, one circular spot approximately in the center, and another boomerang-shaped spot toward the tip of the forewing.

Moths lay white egg masses on the upper surface of corn leaves. These egg masses contain 20-200 tightly clustered eggs. As they develop, the eggs change color from creamy white to tan. They remain tan for 2-5 days, then turn a deep purple 12-24 hours before the larvae emerge.

First instar larvae are dull orange with a black head. Full-grown larvae are 1.5 inches long and tan in color, with two, broad brown stripes on the pronotum ("neck" area behind the head). This insect can be distinguished from the corn earworm by the dark stripes behind the head and the absence of dark spines, tubercles (warts), or stripes on the side of the body.

WBCW has one generation per year and overwinters as full-grown larva in the ground inside a soil chamber. Spring development begins when temperatures exceed 50°F. Larvae pupate in the soil in May, and moths

begin to emerge in late June or early July depending upon degree day heat unit accumulation, which varies slightly by area of the state. Half of the season's WBCW moth population will have emerged at 1,422 degree days, known as the peak flight period.

The female moth is most attracted to corn just before tasseling and lays eggs on the upper leaf surface of the topmost leaf on the plant and on leaves in the ear zone above and below the developing ear. If the tassel has not yet emerged when eggs hatch, larvae crawl into the whorl and feed on pollen. As the tassel emerges, larvae switch to feeding on green silks and enter the developing ear through silk channels or chew directly through the husk to feed anywhere on the ear. Multiple larvae may be found feeding on one ear.

Pheromone traps or degree days can be used to monitor adult emergence, egg-laying, and larval hatch in the field. For details, consult midsummer issues of the UW-Extension Wisconsin Crop Manager newsletter ([ipcm.wisc.edu/wcm](http://ipcm.wisc.edu/wcm)) and the DATCP Wisconsin Pest Bulletin ([datcpservices.pestbulletin.wi.gov](http://datcpservices.pestbulletin.wi.gov)).

Once WBCW degree-day accumulation indicates 25% moth emergence or when the first moths are detected in a pheromone trap in your area, examine 20 consecutive corn plants

at five locations in the field to obtain a representative field sample. Check the upper three to four leaves of each plant and leaves above and below the ear zone for eggs and small larvae. Scout fields that are tasseling first. When scouting post-whorl corn, also look for small larvae on leaf axils, at the intersection of the leaf and stalk, and on silks and husks.

Foliar insecticides effectively suppress larval populations but only if applied before larvae enter the ear to feed. Once larvae have tunneled into the ear, they're protected from foliar insecticides.

For field corn, insecticide treatment should be considered when 5% of plants sampled have egg masses and/or small larvae; for processing sweet corn the threshold is lowered to 4% infestation. Application timing is critical. In fields that have reached or exceeded the economic threshold, if eggs have hatched, the insecticide should be applied after 95% tassel emergence, but before larvae enter the silks. If egg hatch has not yet occurred and plants have tasseled, time insecticide application as close to the expected egg hatch as possible when egg masses have reached the dark purple color stage.

Transgenic corn is another option for managing WBCW in field corn. However, not all proteins provide ad-

**Table 2-8.** Economic thresholds for stalk borer in corn, based on leaf stage, market value and expected yield

Leaf stage	\$3/bu				\$4/bu				\$5/bu				\$6/bu			
	----- Expected yield (bu/a) -----				----- Expected yield (bu/a) -----				-----Expected yield (bu/a) -----				-----Expected yield (bu/a)- -----			
	150	175	200	225	150	175	200	225	150	175	200	225	150	175	200	225
1	5.8	4.9	4.3	3.8	4.3	3.7	3.2	2.9	3.5	3.0	2.6	2.3	3.0	2.5	2.2	1.9
2	7.1	6.0	5.3	4.7	5.3	4.5	4.0	3.5	4.2	3.6	3.2	2.8	3.5	3.0	2.7	2.4
3	9.3	8.0	7.0	6.2	7.0	6.0	5.3	4.7	5.6	4.8	4.2	3.7	4.7	4.0	3.5	3.1
4	9.9	8.5	7.4	6.6	7.4	6.4	5.6	5.0	5.9	5.1	4.5	4.0	5.0	4.3	3.7	3.3
5	11.3	9.7	8.5	7.6	8.5	7.3	6.4	5.7	6.8	5.8	5.1	4.5	5.7	4.9	4.3	3.8
6	19.8	17.0	14.9	13.2	14.9	12.8	11.2	9.9	11.9	10.2	8.9	7.9	9.9	8.5	7.4	6.6
7	54.7	46.9	41.1	36.5	41.1	35.2	30.8	27.4	32.8	28.2	24.6	21.9	27.4	23.5	20.5	18.2

Thresholds based on \$13.00/acre control costs and 80% control with insecticides. (Adapted from Erin Hodgson, Iowa State University.)

equate control when populations are high. For details, see the **Transgenic Bt Corn** section.

## Bt sprays and transgenic Bt corn for insect control

### Bt sprays

The soil bacterium *Bacillus thuringiensis* (Bt) occurs naturally worldwide. Spores produced by the bacterium contain a protein that when ingested by a susceptible insect, ruptures the insect's midgut membrane, preventing further feeding and killing the insect. There are many different strains of the Bt bacterium, each with specificity toward different groups of insects.

Bt has been commercially available as a microbial foliar insecticide for Lepidoptera (caterpillar) larvae such as European corn borer for decades. Bt spray formulations are applied to leaves and other areas where the insect larvae feed. Bt sprays have a relatively short residual in the field, thus a well-timed single application or, more typically, multiple applications based on pest insect scouting and target pest life stage are necessary to maintain control.

Some microbial Bt sprays are listed by the Organic Materials Review Institute (OMRI) for use in USDA-certified organic production. Refer to product labels for Lepidoptera species controlled. Bt sprays are safe for beneficial insects, such as parasitic wasps that attack European corn borer eggs, and predators such as lady beetles that feed on other pest insect eggs, immatures, and/or adults.

### Transgenic Bt corn

Transgenic Bt corn hybrids are genetically modified organisms (GMOs) in which corn has had a gene inserted from an unrelated organism, in this case, Bt. The introduced gene produces a Bt protein toxin with insecticidal activity against a particular target

insect group. Plants with this trait are commonly referred to as Bt crops.

Unlike Bt microbial spray formulations that have a field residual measured in days, the Bt toxin in transgenic Bt corn is active for the life of the plant. This leads to more consistent and economic insect control in years when target insect populations reach economic threshold levels.

However, widespread planting of Bt corn imposes selection on target insects to develop resistance. Because Bt traits are pesticidal substances produced by plants, the US EPA regulates Bt crops through the Federal Insecticide Fungicide and Rodenticide Act. Recognizing the threat of resistance, the EPA also requires seed companies to include an insect resistance management (IRM) plan when applying to register a Bt trait. The goal of an IRM plan is to delay resistance in target insect pest populations. The IRM plan is implemented by planting refuge corn on each farm or field where Bt corn is planted. Refuge corn does not contain the Bt trait(s) used for the target pests in the Bt corn plants.

Depending on the type of Bt corn, the refuge must be planted to a specific percentage of corn acreage on each farm or each field where Bt corn is planted, and there are configuration and distance requirements to adhere to in placing IRM refuge corn within and among fields. Additionally, many Bt corn hybrids are packaged and sold as "refuge in the bag (RIB)" where non-Bt corn seeds are mixed in with the Bt corn seed at a specific percentage of total seed in the bag and growers do not need to plant a structured refuge (see Table 2-9).

The objective of IRM is to maintain Bt susceptible insect populations by way of the refuge. A refuge provides a corn crop habitat that allows target pest insects to develop without being exposed to the Bt trait. Without a refuge, target insect populations exposed to Bt corn each growing season over multiple generations will eventually become resistant to Bt. Mating between Bt-susceptible

insects from the refuge and potential resistant insects from Bt corn minimizes the chances of fully resistant target insect pest populations developing in the field.

### Bt corn insect traits and refuge requirements

For growers who incorporate Bt corn trait technology into their insect pest management strategy, Bt insect trait decisions are made during the hybrid selection process. Moreover, all Bt corn hybrids are sold with a low rate neonicotinoid insecticide seed treatment for protection against early season soil insect pests. Seed traits and seed treatment are input costs committed to before planting. This requires a good understanding of these inputs to make sure they are a necessary, effective, and economical fit for insect pest populations and history on a given farm and crop rotation.

Table 2-9 provides an overview of the increasing array of Bt corn products available. This includes single Bt trait corn hybrids targeting one insect pest group (corn rootworms or corn borers), 'stacked' Bt trait hybrids (e.g., single trait targeting corn rootworms and at least one additional trait targeting aboveground corn borers), and 'pyramided' trait hybrids, with two or more Bt proteins targeting the same insect pest group.

### Summary

For structured refuges (planted as blocks or strips within fields), the refuge corn should have a relative maturity that is compatible with the Bt corn. Plant the refuge at the same time as the Bt corn and plant it in an area with the same crop rotation history. The non-Bt rootworm refuge may be treated with soil applied or seed-applied insecticides labeled for corn rootworm at planting. The non-Bt corn borer refuge may be treated with conventional foliar insecticides (but not Bt insecticide) only if target pest pressure reaches economic thresholds. It will not be practical to

spray the non-Bt corn in a strip configuration within a field.

Crop rotation sequence, insect field scouting records, state pest survey data, and historical insect problems on your farm will help guide your decision when selecting corn hybrids with Bt traits.

When selecting corn hybrids, keep in mind that Bt insect protection is only one of many factors that should go into the decision. Evaluate the cost of added protection with Bt traits and decide if the cost is justified for your situation. Just because you can buy a trait doesn't mean you need that trait. Data from the University of Wisconsin Department of Agronomy corn hybrid yield trials can help you choose the best hybrid for your location. This information is updated annually and is available through your county Extension office or at [corn.agronomy.wisc.edu](http://corn.agronomy.wisc.edu)

### Resistance to Bt corn hybrids

Field-evolved resistance has recently been detected for the European corn borer in Nova Scotia. Although not close to the Midwest, it does indicate that this species is capable of developing resistance and that management practices should be used to delay resistance. Furthermore, despite the requirement that growers plant a refuge to delay resistance development, field-evolved resistance by both the western and northern corn rootworm occurred in a relatively short period of time since commercial release of the first Bt rootworm corn in 2003. In addition to planting the required refuge, the following recommendations can help corn growers to delay further resistance and conserve susceptibility to Bt corn:

- **Scout for damage from European corn borer.**
- **Scout for rootworm beetles.** Beetle populations can vary from year to year and field to field. Counting beetles during the egg-laying period can determine if there is a need for control in next year's corn and

may help in choosing the most appropriate control method to avoid resistance. For more information on rootworm beetle scouting go to <http://ipcm.wisc.edu/download/pubsPM/Corn-rootworm-card-2015hx.pdf>

- **Evaluate corn roots for signs of larval feeding.** Doing so may provide an early warning for resistance on continuous corn and the presence/absence of rotation resistance western corn rootworm on first-year corn. For more information on rating damaged corn roots go to <http://ipcm.wisc.edu/download/pubsPM/Corn-root-Rate-card2015hx.pdf>
- **Rotate to soybean or another non-host crop** to break the corn rootworm life cycle.
- **Consider the use of an at-plant, soil applied insecticide** labeled for corn rootworm control with a conventional, non-Bt CRW hybrid.
- **Consider the use of a high rate of a neonic seed treatment as a primary rootworm control practice IF** the previous year's beetle scouting records indicate low to moderate beetle populations.
- **Rotate Bt CRW toxins.** Do not use the same Bt toxin for more than two consecutive years whether it is a single, stacked or pyramided trait. Annual rotation is preferred.
- **Adult suppression may be an appropriate remediation step** for one or two growing seasons in fields with confirmed resistance, if crop rotation is not an option or a suitable Bt pyramid is not available. In such cases, soil insecticide applied to non-Bt corn will offer root protection while adulticides will reduce the number of resistant adults that survive in the field. This should be followed by a long-term IPM approach using a mix of tactics.
- **Most importantly, implement a long-term integrated approach to corn rootworm management,** based on scouting information

and knowledge of corn rootworm densities, that uses multiple tactics such as rotation to a non-host crop, rotation of Bt toxins, and the use of soil insecticides at planting with a non-Bt hybrid.

**Table 2-9. Handy Bt Table**  
Chris DiFonzo, Michigan State University

# The Handy Bt Trait Table

## for U.S. Corn Production

Updated 2 February 2023

**Compiled by**  
Chris DiFonzo  
Michigan State University

**Web site hosting by**  
Pat Porter  
Texas A&M University

The most up-to-date version of this table plus related extension materials are free online at:  
<https://www.texasinsects.org/bt-corn-trait-table.html>  
Questions? Comments? Complaints? difonzo@msu.edu

The Handy Bt Trait Table provides a helpful list of trait packages to make it easier to understand seed guides, sales materials, and bag tags.

The big change for 2023: The table increased from one to two pages. Companies continue to recombine existing insect modes of action, rename trait stacks (as Syngenta did for 2023), and add Enlist technology (providing tolerance to 2,4-D and fops herbicides) to existing hybrid packages. Each new combination and new name increased the length of the table. The font size and spacing on the one-page version decreased to a point where it was too small. To remedy this, I flow the 2023 table over two pages. Where possible, the font size increased, and a new column was added for bag tag letter codes. For those who need it, the table of 'transformation events', on page 1 of previous tables, has moved online.

I am often asked why older trait packages, with limited or no commercial availability, remain on the table. This is for historical reference, so you can look back and interpret previous year's planting records, seed guides, and research results. Also, companies often refer to older trait stack names in current seed guides (e.g. 'AwesomeSeed's new XYZ Pro is a combination of trait packages A, B, and C'). Thus, the Handy Bt Trait Table is a one-stop shop for both past and present Bt hybrid information.

### ABBREVIATIONS in the TRAIT TABLE

#### Insect Pest Targets

BCW	black cutworm
CEW	corn earworm
CRW	corn rootworm
ECB	European corn borer
FAW	fall armyworm
NCR	northern corn rootworm
SB	stalk borer
SCB	sugarcane borer
SWCB	southwestern corn borer
TAW	true armyworm
WBC	western bean cutworm
WCR	western corn rootworm

#### Herbicide Tolerance

GLY	glyphosate / Roundup-Ready
LL	glufosinate / Liberty Link
2,4D	2,4-D
fops	group 1 'fops'

Trait packages, listed A-Z <small>= former name if applicable</small>	Bag- tag Code	Toxins in package *****  Font type denotes target: caterpillar or rootworm	Marketed to control:												Resistance cases for all Bts in package	Non-Bt refuge cornbelt	Herbicide tolerance
			B C W	C E W	E C B	F A W	S C B	S W C B	T A W	W B C	W C R	W C R	W C R	W C R			
AcreMax	AM	Cry1Ab - Cry1F	x	x	x	x	x	x	x						CEW FAW WBC	5% in bag	GLY LL
AcreMax CRW	AMRW	Cry34Ab1 - Cry35Ab1												x	NCR WCR	10% in bag	GLY LL
AcreMax1	AM1	Cry1F - Cry34Ab1 - Cry35Ab1	x		x	x	x	x	x					x	ECB FAW NCR SWCB WBC WCR	10% in bag 20% ECB	GLY LL
AcreMax Leptra	AML	Cry1Ab - Cry1F - Vip3A	x	x	x	x	x	x	x	x	x					5% in bag	GLY LL
AcreMax TRIsect	AMT	Cry1Ab - Cry1F - mCry3A	x	x	x	x	x	x	x					x	CEW FAW WBC WCR	10% in bag	GLY LL
AcreMax Xtra	AMX	Cry1Ab - Cry1F - Cry34Ab1 - Cry35Ab1	x	x	x	x	x	x	x					x	CEW FAW NCR WBC WCR	10% in bag	GLY LL
AcreMax Xtreme	AMXT	Cry1Ab - Cry1F - Cry34Ab1 - Cry35Ab1 - mCry3A	x	x	x	x	x	x	x					x	CEW FAW WBC WCR	5% in bag	GLY LL
Agrisure 3010	3010	Cry1Ab		x	x			x	x						CEW	20%	GLY LL
Agrisure 3000 GT & 3011A	3000GT 3011A	Cry1Ab - mCry3A		x	x			x	x					x	CEW WCR	20%	GLY LL
Agrisure Above = Agrisure 3120EZ	AA	Cry1Ab - Cry1F	x	x	x	x	x	x	x						CEW FAW WBC	5% in bag	GLY LL - check bag
Agrisure Total = Agrisure 3122EZ	AT	Cry1Ab - Cry1F - Cry34Ab1 - Cry35Ab1 - mCry3A	x	x	x	x	x	x	x					x	CEW FAW WBC WCR	5% in bag	GLY LL - check bag
Agrisure Viptera 3110	3110	Cry1Ab - Vip3A	x	x	x	x	x	x	x	x	x					20%	GLY LL
Agrisure Viptera 3111	3111	Cry1Ab - Vip3A - mCry3A	x	x	x	x	x	x	x	x	x	x			WCR	20%	GLY LL

Continued on next page

**Table 2-9.** Handy Bt trait table (continued)

Trait packages, listed A-Z = former name if applicable	Bag- tag Code	Toxins in package ***** Font type denotes target: caterpillar or rootworm	Marketed to control:												Resistance cases for all Bts in package	Non-Bt refuge cornbelt	Herbicide tolerance
			B C W	C E W	E C B	F A B	S B	S C B	S W C B	T A W	T B C	W R W					
Duracade = AgrisureDuracade 5122EZ	D	Cry1Ab - Cry1F - <i>eCry3.1Ab</i> - <i>mCry3A</i>	x	x	x	x	x	x	x				x	CEW FAW WBC WCR	5% in bag	GLY LL - check bag	
Duracade Viptera = AgrisureDuracade 5222EZ	DV	Cry1Ab - Cry1F - Vip3A - <i>eCry3.1Ab</i> - <i>mCry3A</i>	x	x	x	x	x	x	x	x	x	x	x	WCR	5% in bag	GLY LL - check bag	
Duracade Viptera Z3 = AgrisureDuracade 5332EZ	DVZ	Cry1Ab - Cry1A.105 - Cry2Ab2 - Vip3A - <i>eCry3.1Ab</i> - <i>mCry3A</i>	x	x	x	x	x	x	x	x	x	x	x	WCR	5% in bag	GLY LL - check bag	
Herculex I	HXI	Cry1F	x		x	x	x	x	x					ECB FAW SWCB WBC	20%	GLY LL	
Herculex RW	HXRW	<i>Cry34Ab1</i> - <i>Cry35Ab1</i>											x	NCR WCR	20%	GLY LL	
Herculex XTRA	HXX	Cry1F - <i>Cry34Ab1</i> - <i>Cry35Ab1</i>	x		x	x	x	x	x				x	ECB FAW NCR SWCB WBC WCR	20%	GLY LL	
Intrasect	YHR	Cry1Ab - Cry1F	x	x	x	x	x	x	x					CEW FAW WBC	5%	GLY LL	
Intrasect TRIsect	CYHR	Cry1Ab - Cry1F - <i>mCry3A</i>	x	x	x	x	x	x	x				x	CEW FAW WBC WCR	20%	GLY LL	
Intrasect Xtra	YXR	Cry1Ab - Cry1F - <i>Cry34Ab1</i> - <i>Cry35Ab1</i>	x	x	x	x	x	x	x				x	CEW FAW NCR WBC WCR	20%	GLY LL	
Intrasect Xtreme	CYXR	Cry1Ab - Cry1F - <i>Cry34Ab1</i> - <i>Cry35Ab1</i> - <i>mCry3A</i>	x	x	x	x	x	x	x				x	CEW FAW WBC WCR	5%	GLY LL	
Leptra	VYHR	Cry1Ab - Cry1F - Vip3A	x	x	x	x	x	x	x	x	x	x			5%	GLY LL	
Powercore	PW	Cry1A.105 - Cry2Ab2 - Cry1F	x	x	x	x	x	x	x					CEW WBC	5%	GLY LL	
Powercore Refuge Advanced	PWRA	Cry1A.105 - Cry2Ab2 - Cry1F	x	x	x	x	x	x	x					CEW WBC	5% in bag	GLY LL	
Powercore Enlist Refuge Advanced	PWE	Cry1A.105 - Cry2Ab2 - Cry1F	x	x	x	x	x	x	x					CEW WBC	5% in bag	GLY LL 2,4-D fops	
QROME	Q	Cry1Ab - Cry1F - <i>Cry34Ab1</i> - <i>Cry35Ab1</i> - <i>mCry3A</i>	x	x	x	x	x	x	x				x	CEW FAW WBC WCR	5% in bag	GLY LL	
SmartStax	SS, SX	Cry1A.105 - Cry2Ab2 - Cry1F - <i>Cry3Bb1</i> - <i>Cry34Ab1</i> - <i>Cry35Ab1</i>	x	x	x	x	x	x	x				x	CEW NCR WBC WCR	5%	GLY LL	
SmartStax Refuge Advanced	SXRA	Cry1A.105 - Cry2Ab2 - Cry1F - <i>Cry3Bb1</i> - <i>Cry34Ab1</i> - <i>Cry35Ab1</i>	x	x	x	x	x	x	x				x	CEW NCR WBC WCR	5% in bag	GLY LL	
SmartStax Enlist	SSE	Cry1A.105 - Cry2Ab2 - Cry1F - <i>Cry3Bb1</i> - <i>Cry34Ab1</i> - <i>Cry35Ab1</i>	x	x	x	x	x	x	x				x	CEW NCR WBC WCR	5% in bag	GLY LL 2,4-D fops	
SmartStax RIB Complete	SS SSRIB	Cry1A.105 - Cry2Ab2 - Cry1F - <i>Cry3Bb1</i> - <i>Cry34Ab1</i> - <i>Cry35Ab1</i>	x	x	x	x	x	x	x				x	CEW NCR WBC WCR	5% in bag	GLY LL	
SmartStax PRO Refuge Advanced	SSPro	Cry1A.105 - Cry2Ab2 - Cry1F - <i>Cry3Bb1</i> - <i>Cry34Ab1</i> - <i>Cry35Ab1</i> - <i>dvSnf7</i>	x	x	x	x	x	x	x				x	CEW WBC	5% in bag	GLY LL	
SmartStax PRO Enlist Refuge Advanced		Cry1A.105 - Cry2Ab2 - Cry1F - <i>Cry3Bb1</i> - <i>Cry34Ab1</i> - <i>Cry35Ab1</i> - <i>dvSnf7</i>	x	x	x	x	x	x	x				x	CEW WBC	5% in bag	GLY LL 2,4-D fops	
SmartStax PRO with RNAi Technology	SSPRORIB	Cry1A.105 - Cry2Ab2 - Cry1F - <i>Cry3Bb1</i> - <i>Cry34Ab1</i> - <i>Cry35Ab1</i> - <i>dvSnf7</i>	x	x	x	x	x	x	x				x	CEW WBC	5% in bag	GLY LL	
Trecepta	TRE,TRC	Cry1A.105 - Cry2Ab2 - Vip3A	x	x	x	x	x	x	x	x	x	x			5%	GLY	
Trecepta RIB Complete	TRERIB TRCRIB	Cry1A.105 - Cry2Ab2 - Vip3A	x	x	x	x	x	x	x	x	x	x			5% in bag	GLY	
TRIssect	CHR	Cry1F - <i>mCry3A</i>	x		x	x	x	x	x				x	ECB FAW SWCB WBC WCR	20%	GLY LL	
Viptera = AgrisureViptera 3220EZ	V	Cry1Ab - Cry1F - Vip3A	x	x	x	x	x	x	x	x	x	x			5% in bag	GLY LL - check bag	
Viptera Z3 = AgrisureViptera 3330EZ	VZ	Cry1Ab - Cry1A.105 - Cry2Ab2 - Vip3A	x	x	x	x	x	x	x	x	x	x			5% in bag	GLY LL - check bag	
Vorceed Enlist	V	Cry1A.105 - Cry2Ab2 - Cry1F - <i>Cry3Bb1</i> - <i>Cry34Ab1</i> - <i>Cry35Ab1</i> - <i>dvSnf7</i>	x	x	x	x	x	x	x				x	CEW NCR WBC	5% in bag	GLY LL 2,4-D fops	
VT Double PRO	VT2P VT2PRO	Cry1A.105 - Cry2Ab2		x	x	x	x	x	x					CEW	5%	GLY	
VT2P RIB Complete	VT2PRIB	Cry1A.105 - Cry2Ab2		x	x	x	x	x	x					CEW	5% in bag	GLY	
VT TriplePRO	VT3P	Cry1A.105 - Cry2Ab2 - <i>Cry3Bb1</i>		x	x	x	x	x	x				x	CEW NCR WCR	20%	GLY	
VT3P RIB Complete	VT3PRIB	Cry1A.105 - Cry2Ab2 - <i>Cry3Bb1</i>		x	x	x	x	x	x				x	CEW NCR WCR	10% in bag	GLY	
VT4Pro w/RNAi Tech. *Expected 2024	VT4PRO	Cry1A.105 - Cry2Ab2 - Vip3A - <i>Cry3Bb1</i> - <i>dvSnf7</i>	x	x	x	x	x	x	x	x	x	x	x		5% in bag	GLY	
Yieldgard Corn Borer	YGCB	Cry1Ab		x	x			x	x					CEW	20%	GLY	
Yieldgard Rootworm	YGRW	<i>Cry3Bb1</i>											x	NCR WCR	20%	GLY	

Principles of pest  
management

Corn insect

Soybean

Forages &  
pastures

Small grains

Stored grain  
insects

Appendix

## Insecticide suggestions for corn pests

### Armyworm

**Threshold:** Treatment is suggested if larvae are 0.75-1.0 inch long or less and two or more larvae per plant can be found on 25% of corn plants or if one larvae per plant is found on 75% of corn plants.

#### Asana XL

**Rate:** 5.8-9.6 fl oz  
**Active ingredient:** esfenvalerate  
**IRAC code:** 3A  
**Preharvest interval (days):** 21  
**Maximum rate:** 0.25 lb ai/a/season

#### *Bacillus thuringiensis* several

**Rate:** See label (rates vary by formulation).  
**Active ingredient:** *Bacillus thuringiensis*  
**IRAC code:** 11  
**Maximum rate:** several formulations available. Consult label.

*Apply while larvae are small.*

#### Baythroid XL

**Rate:** 1.6-2.8 fl oz  
**Active ingredient:** beta-cyfluthrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 21 for grain or fodder, 0 for green forage  
**Maximum rate:** 11.2 fl oz/a (0.088 lb ai/a) per season

*Labeled for 1<sup>st</sup> and 2<sup>nd</sup> instar larvae.*

#### Besiege

**Rate:** 6.0-10.0 fl oz  
**Active ingredient:** lambda-cyhalothrin + chlorantraniliprole  
**IRAC code:** 3A, 28  
**Preharvest interval (days):** 21 for grain; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after last treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.  
**Maximum rate:** Total of 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products/a/year. Do not apply more than 18.0 fl oz/a after silk initiation or 10.0 fl oz/a after milk stage.

#### Brigade 2EC

**Rate:** 2.1-6.4 fl oz  
**Active ingredient:** bifenthrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application.  
**Maximum rate:** 0.3 lb ai/a/season including PRE and PPI, at plant, plus foliar applications. Use of ultra low volume (ULV) application on corn is prohibited.

#### Coragen 1.67SC

**Rate:** 3.5-7.5 fl oz  
**Active ingredient:** chlorantraniliprole  
**IRAC code:** 28  
**Preharvest interval (days):** 14  
**Maximum rate:** 15.4 fl oz Coragen or 0.2 lb ai of chlorantraniliprole containing products/a/crop. Do not make more than 4 applications/a/crop.

#### Declare

**Rate:** 1.02-1.54 fl oz  
**Active ingredient:** gamma-cyhalothrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 21  
**Maximum rate:** 0.06 lb ai/a (0.38 pt/a)/crop from at plant and foliar applications. Do not apply more than 0.03 lb ai (0.19 pt) after silk initiation or more than 0.015 lb ai (0.096 pt) after milk stage.

*Use higher rates for large larvae.*

#### Delta Gold 1.5EC

**Rate:** 1.5-1.9 fl oz  
**Active ingredient:** deltamethrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 21 for grain or fodder; Do not apply within 12 days of cutting or grazing field corn for forage.  
**Maximum rate:** 8.1 fl oz/a (0.095 lb ai/a) on field corn in one growing season. Do not make more than 5 applications/a/season.

*Apply to early instar larvae.*

#### Fanfare EC, 2 EC and ES

**Rate:** 2.1-6.4 fl oz/a  
**Active ingredient:** bifenthrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of the last application.  
**Maximum rate:** Do not apply more than 0.3 lb active ingredient (19.2 oz formulated)/a/season

#### Fastac EC, SC

**Rate:** 3.2-3.8 fl oz  
**Active ingredient:** alpha-cypermethrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 30 for grain, 60 for forage  
**Maximum rate:** 11.4 fl oz/a/season

#### Hero

**Rate:** 4.0-10.3 fl oz  
**Active ingredient:** zeta-cypermethrin, bifenthrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 30 for grain, 60 for forage; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of the last application.  
**Maximum rate:** 10.3 oz or 0.10 lb ai/application. Do not apply more than 41.2 oz or 0.4 lb ai/a/season including at-plant and foliar applications. Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin to corn. Use of ultra low volume (ULV) application on corn is prohibited.

#### Intrepid 2F

**Rate:** 4.0-16.0 fl oz  
**Active ingredient:** methoxyfenozide  
**IRAC code:** 18  
**Preharvest interval (days):** 21 for grain  
**Maximum rate:** 16 fl oz/a/application or more than a total of 64 fl oz/a (1 lb ai/a)/year

#### Intrepid Edge

**Rate:** 4.0-12.0 fl oz  
**Active ingredient:** methoxyfenozide, spinetoram  
**IRAC code:** 18, 5  
**Preharvest interval (days):** 28 for grain  
**Maximum rate:** 12 fl oz/a/application or more than a total of 32 fl oz/a of Intrepid Edge (0.625 lb ai methoxyfenozide, 0.125 lb ai spinetoram)/a/year

#### Lannate LV

**Rate:** 0.75-1.5 pt  
**Active ingredient:** methomyl  
**IRAC code:** 1A  
**Preharvest interval (days):** 21 for ears and stover, 3 for forage  
**Maximum rate:** 7.5 pt/a/crop

*High acute toxicity to humans. Highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply or allow it to drift to blooming crops or weeds while bees are visiting the treatment area.*

## Lannate SP

**Rate:** 0.25-0.50 lb

**Active ingredient:** methomyl

**IRAC code:** 1A

**Preharvest interval (days):** 21 for ears and stover, 3 for forage

**Maximum rate:** 2.5 lb/a/crop

*High acute toxicity to humans. Highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply or allow it to drift to blooming crops or weeds while bees are visiting the treatment area.*

## Mustang Maxx

**Rate:** 3.2-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 7 for grain stover and forage

**Maximum rate:** 16 oz/a or 0.10 lb ai/a/season

## Paradigm

**Rate:** 2.56-3.84 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Do not apply more than 0.12 lb ai (0.96 pt)/a/crop from at-plant and foliar applications. Do not apply more than 0.06 lb ai (0.48 pt) after silk initiation. Do not apply more than 0.03 lb ai (0.24 pt) after corn has reached the milk stage (yellow kernel with milk fluid).

## Prevathon

**Rate:** 14.0 - 20.0 fl oz./a

**Active ingredient:** chlorantraniliprole

**IRAC code:** 28

**Preharvest interval (days):** 14 for ears, 1 for forage, fodder, silage, stover

**Maximum rate:** 60 fl oz of chlorantraniliprole-containing products/season, 4 applications/year

## Sevin XLR Plus

**Rate:** 1.0-2.0 qt

**Active ingredient:** carbaryl

**IRAC code:** 1A

**Preharvest interval (days):** 48 for grain and fodder, 14 for harvest or grazing of forage or silage

**Maximum rate:** 8 qt/a/crop/year

*Bee Precaution: Do not apply this product to target crops or weeds in bloom.*

## Silencer

**Rate:** 2.56-3.84 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Do not apply more than 0.12 lb ai (0.96 pt)/a/crop from at-plant and foliar applications. Do not apply more than 0.06 lb ai (0.48 pt) after silk initiation. Do not apply more than 0.03 lb ai (0.24 pt) after corn has reached the milk stage (yellow kernel with milk fluid).

## Tracer

**Rate:** 1.0-3.0 fl oz

**Active ingredient:** spinosad

**IRAC code:** 5

**Preharvest interval (days):** 28 for grain, 3 for forage or fodder

**Maximum rate:** 6 fl oz/a (0.188 lb ai/a)/year

## Warrior II

**Rate:** 1.28-1.92 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.12 lb ai/a (7.68 fl oz or 0.48 pt/a)/crop from at plant and foliar applications; 0.06 lb ai/a (3.84 fl oz or 0.24 pt/a) after silk initiation. Do not apply more than 0.03 lb ai/a (1.92 fl oz or 0.12 pt/a) after corn has reached the milk stage.

*Use higher rates for large larvae.*

## Billbug

**Threshold:** No thresholds established. Control is warranted when adult feeding damage is killing plants and reducing stands. There is no rescue treatment for larvae feeding inside corn stalks.

## Counter 20G

**Rate:** 4.5-6.0 oz/1,000 ft row

**Active ingredient:** terbufos

**IRAC code:** 1B

**Preharvest interval (days):** DO NOT graze or cut for forage within 30 days of treatment

**Maximum rate:** 6.5 lb/a; ALS-inhibiting herbicides SHOULD NOT be used if applied to corn at the time of planting. (This includes Accent, Accent Gold, Basis Gold, Steadfast, Beacon, Exceed, Hornet, Permit, Scorpion III, Celebrity Plus, Lightning, Northstar, and Spirit herbicides). Apply as 4- to 5-in band or in-furrow.

## Counter 20G SmartBox

**Rate:** 4.5-6.0 oz/1,000 ft row

**Active ingredient:** terbufos

**IRAC code:** 1B

**Preharvest interval (days):** DO NOT graze or cut for forage within 30 days of treatment

**Maximum rate:** 6.5 lb/a; ALS-inhibiting herbicides SHOULD NOT be used if applied to corn at the time of planting. (This includes Accent, Accent Gold, Basis Gold, Steadfast, Beacon, Exceed, Hornet, Permit, Scorpion III, Celebrity Plus, Lightning, Northstar, and Spirit herbicides). Apply as 4- to 5-in band or in-furrow.

## Cruiser 5 FS

**Rate:** 1.25 mg/seed

**Active ingredient:** thiamethoxam

**IRAC code:** 4A

*Do not use treated seed for feed, food or oil purposes. Bee Precaution: Thiamethoxam is highly toxic to bees, and effects are possible as a result of exposure to translocated residues in blooming crops.*

## Poncho 600

**Rate:** 1.25 mg/seed

**Active ingredient:** clothianidin

**IRAC code:** 4A

**Maximum rate:** 1.25 mg/seed

*Do not use treated seed for food, feed, or oil processing. This compound is toxic to birds and mammals. Treated seeds exposed on soil surface may be hazardous to birds and mammals. Cover or collect treated seeds spilled during loading.*

*Follow-up foliar sprays of a registered insecticide may be needed under heavy billbug pressure.*

## Corn earworm

**Threshold:** Control occasionally required in hybrid seed production fields. Treat before brown silk stage.

## Asana XL

**Rate:** 5.8-9.6 fl oz

**Active ingredient:** esfenvalerate

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.25 lb ai/a/season

First application should be at or before silking. Repeat applications if economically damaging populations exist. Subsequent applications until silking is completed.

## Baythroid XL

**Rate:** 1.6-2.8 fl oz

**Active ingredient:** beta-cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21 for grain or fodder, 0 for green forage

**Maximum rate:**

11.2 fl oz/a (0.088 lb ai/a)/season

## Besiege

**Rate:** 5.0-10.0 fl oz

**Active ingredient:** lambda-cyhalothrin + chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 21 for grain; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after last treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Total of 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products/a/year. Do not apply more than 18.0 fl oz/a after silk initiation or 10.0 fl oz/a after milk stage.

*For control before larvae enter the ear.*

## Brigade 2EC

**Rate:** 2.1-6.4 fl oz

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application.

**Maximum rate:** 0.3 lb ai/a/season including PRE and PPI, at plant, plus foliar applications. Use of ultra low volume (ULV) application on corn is prohibited.

## Coragen SC

**Rate:** 3.5-7.5 fl oz

**Active ingredient:** chlorantraniliprole

**IRAC code:** 28

**Preharvest interval (days):** 14

**Maximum rate:** 15.4 fl oz Coragen or 0.2 lb ai of chlorantraniliprole containing products/a/crop. Do not make more than 4 applications/a/crop.

## Declare

**Rate:** 0.77-1.28 fl oz

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.06 lb ai/a (0.38 pt/a)/crop from at plant and foliar applications. Do not apply more than 0.03 lb ai (0.19 pt) after silk initiation or more than 0.015 lb ai (0.096 pt) after milk stage.

*For control before the larvae bore into the ear.*

## Delta Gold 1.5EC

**Rate:** 1.5-1.9 fl oz

**Active ingredient:** deltamethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21 for grain or fodder; Do not apply within 12 days of cutting or grazing field corn for forage.

**Maximum rate:** 8.1 fl oz/a (0.095 lb ai/a) on field corn in one growing season. Do not make more than 5 applications/a/season.

*Apply to early instar larvae prior to boring into ear.*

## Fanfare EC, 2EC and ES

**Rate:** 2.1-6.4 fl oz/a

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of the last application.

**Maximum rate:** Do not apply more than 0.3 lb active ingredient (19.2 oz formulated)/a/season.

## Fastac EC, SC

**Rate:** 1.3-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 for grain, 60 for forage

**Maximum rate:** 11.4 fl oz/a/season

## Hero

**Rate:** 4.0-10.3 fl oz

**Active ingredient:** zeta-cypermethrin, bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 for grain, 60 for forage; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of the last application.

**Maximum rate:** 10.3 oz or 0.10 lb ai/application. Do not apply more than 41.2 oz or 0.4 lb ai/a/season including at-plant and foliar applications. Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin to corn.

thrin or bifenthrin to corn.

Use of ultra low volume (ULV) application on corn is prohibited.

## Intrepid Edge

**Rate:** 8.0-12.0 fl oz

**Active ingredient:** methoxyfenozide, spinetoram

**IRAC code:** 18, 5

**Preharvest interval (days):** 28 for grain

**Maximum rate:** 12 fl oz/a/application or more than a total of 32 fl oz/a of Intrepid Edge (0.625 lb ai methoxyfenozide, 0.125 lb ai spinetoram)/a/year

## Lannate LV

**Rate:** 0.75-1.5 pt

**Active ingredient:** methomyl

**IRAC code:** 1A

**Preharvest interval (days):** 21 for ears and stover, 3 for forage

**Maximum rate:** 7.5 pt/a/crop

*High acute toxicity to humans. Highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply or allow it to drift to blooming crops or weeds while bees are visiting the treatment area.*

## Lannate SP

**Rate:** 0.25-0.50 lb

**Active ingredient:** methomyl

**IRAC code:** 1A

**Preharvest interval (days):** 21 for ears and stover, 3 for forage

**Maximum rate:** 2.5 lb/a/crop

*High acute toxicity to humans. Highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply or allow it to drift to blooming crops or weeds while bees are visiting the treatment area.*

## Mustang Maxx

**Rate:** 1.76-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 7 for grain, stover and forage

**Maximum rate:** 16 oz/a or 0.10 lb ai/a/season

*For control before the larvae bore into the ear.*

## Paradigm

**Rate:** 1.92-3.2 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21; Do not allow livestock to graze in treated areas or harvest treated

corn forage as feed for meat or dairy animals within 1 day after treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Do not apply more than 0.12 lb ai (0.96 pt)/a/crop from at-plant and foliar applications. Do not apply more than 0.06 lb ai (0.48 pt) after silk initiation. Do not apply more than 0.03 lb ai (0.24 pt) after corn has reached the milk stage (yellow kernel with milk fluid).

## Prevathon

**Rate:** 14.0-20.0 fl oz/a

**Active ingredient:** chlorantraniliprole

**IRAC code:** 28

**Maximum rate:** No more than 60 fl oz/a of chlorantraniliprole containing products/year, 4 applications/year

## Sevin XLR Plus

**Rate:** 1.0-2.0 qt

**Active ingredient:** carbaryl

**IRAC code:** 1A

**Preharvest interval (days):** 48 for grain and fodder, 14 for harvest or grazing of forage or silage

**Maximum rate:** 8 qt/a/crop/year

*Bee Precaution: Do not apply this product to target crops or weeds in bloom.*

## Silencer

**Rate:** 1.92-3.2 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Do not apply more than 0.12 lb ai (0.96 pt)/a/crop from at-plant and foliar applications. Do not apply more than 0.06 lb ai (0.48 pt) after silk initiation. Do not apply more than 0.03 lb ai (0.24 pt) after corn has reached the milk stage (yellow kernel with milk fluid).

## Tracer

**Rate:** 2.0-3.0 fl oz

**Active ingredient:** spinosad

**IRAC code:** 5

**Preharvest interval (days):** 28 for grain, 3 for forage or fodder

**Maximum rate:** 6 fl oz/a (0.188 lb ai/a)/year

## Warrior II

**Rate:** 1.28-1.92 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.12 lb ai/a (7.68 fl oz or 0.48 pt/a)/crop from at plant and foliar applications; 0.06 lb ai/a (3.84 fl oz or 0.24 pt/a) after silk initiation. Do not apply more than 0.03 lb ai/a (1.92 fl oz or 0.12 pt/a) after corn has reached the milk stage.

## Corn leaf aphid

**Threshold:** Treat if 50% of corn plants have more than 50 aphids per plant and plants are in the late whorl to early tassel stage.

## Asana XL

**Rate:** 5.8-9.6 fl oz

**Active ingredient:** esfenvalerate

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.25 lb ai/a/season

For optimum results, direct the spray at the aphid population so as to achieve maximum coverage of the exposed insects. Aphids not contacted by the spray, such as in whorls and leaf axils, may not be adequately controlled.

## Avicta Complete Corn

**Rate:** 0.534 mg/seed

**Active ingredient:** thiamethoxam, abamectin

**IRAC code:** 4A, 6

**Maximum rate:** 0.534 mg/seed

## Besiege

**Rate:** 6.0-10.0 fl oz

**Active ingredient:** lambda-cyhalothrin + chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 21 for grain; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after last treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Total of 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products/a/year. Do not apply more than 18.0 fl oz/a after silk initiation or 10.0 fl oz/a after milk stage.

## Brigade 2EC

**Rate:** 2.1-6.4 fl oz

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application.

**Maximum rate:** 0.3 lb ai/a/season including PRE and PPI, at plant, plus foliar applications. Use of ultra low volume (ULV) application on corn is prohibited.

## Delta Gold 1.5EC

**Rate:** 1.5-1.9 fl oz

**Active ingredient:** deltamethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21 for grain or fodder. Do not apply within 12 days of cutting or grazing field corn for forage.

**Maximum rate:** 8.1 fl oz/a (0.095 lb ai/a) on field corn in one growing season. Do not make more than 5 applications/a/season.

*Suppression only.*

## Dimethoate

**Rate:** see label

**Active ingredient:** dimethoate

**IRAC code:** 1B

**Preharvest interval (days):** 28 for grain, 14 for forage

**Maximum rate:** Maximum application rate 0.5 lb ai/a

*Bee precaution: Do not apply to corn during pollen shed period if bees are present. Workers are prohibited from entering treated area to perform detassling tasks for 4 days in non-arid areas and for 15 days in outdoor areas where average rainfall is less than 25 inches/year. Do not apply in tank-mixes with ALS herbicides*

## Fanfare EC, 2 EC and ES

**Rate:** 2.1-6.4 fl oz/a

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of the last application.

**Maximum rate:** Do not apply more than 0.3 lb active ingredient (19.2 oz formulated)/a/season.

## Fastac EC, SC

**Rate:** 2.7-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 for grain, 60 for forage

**Maximum rate:** 11.4 fl oz/a/season

## Hero

**Rate:** 4.0-10.3 fl oz

**Active ingredient:** zeta-cypermethrin, bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 for grain, 60 for forage; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of the last application.

**Maximum rate:** 10.3 oz or 0.10 lb ai/application. Do not apply more than 41.2 oz or 0.4 lb ai/a/season including at-plant and foliar applications. Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin to corn.

Use of ultra low volume (ULV) application on corn is prohibited.

## Lannate LV

**Rate:** 0.75-1.5 pt

**Active ingredient:** methomyl

**IRAC code:** 1A

**Preharvest interval (days):** 21 for ears and stover, 3 for forage

**Maximum rate:** 7.5 pt/a/crop

*High acute toxicity to humans. Highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply or allow it to drift to blooming crops or weeds while bees are visiting the treatment area.*

## Lannate SP

**Rate:** 0.25-0.50 lb

**Active ingredient:** methomyl

**IRAC code:** 1A

**Preharvest interval (days):** 21 for grain, ears and stover, 3 for forage

**Maximum rate:** 2.5 lb/a/crop

*High acute toxicity to humans. Highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply or allow it to drift to blooming crops or weeds while bees are visiting the treatment area.*

## Mustang Maxx

**Rate:** 2.72-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 7 for grain stover and forage

**Maximum rate:** 16 oz/a or 0.10 lb ai/a/season

## Paradigm

**Rate:** 2.56-3.84 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Do not apply more than 0.12 lb ai (0.96 pt)/a/crop from at-plant and foliar applications. Do not apply more than 0.06 lb ai (0.48 pt) after silk initiation. Do not apply more than 0.03 lb ai (0.24 pt) after corn has reached the milk stage (yellow kernel with milk fluid).

## Silencer

**Rate:** 2.56-3.84 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Do not apply more than 0.12 lb ai (0.96 pt)/a/crop from at-plant and foliar applications. Do not apply more than 0.06 lb ai (0.48 pt) after silk initiation. Do not apply more than 0.03 lb ai (0.24 pt) after corn has reached the milk stage (yellow kernel with milk fluid).

## Corn rootworm beetle

**Threshold:** For pollination protection. Treat before pollination is 50% complete, silk clipping is observed, and five or more beetles are observed/plant.

## Asana XL

**Rate:** 5.8-9.6 fl oz

**Active ingredient:** esfenvalerate

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.25 lb ai/a/season

*Apply at first sign of silk feeding.*

## Baythroid XL

**Rate:** 1.6-2.8 fl oz

**Active ingredient:** beta-cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21 for grain or fodder, 0 for green forage.

**Maximum rate:** 11.2 fl oz/a (0.088 lb ai/a)/season

## Besiege

**Rate:** 6.0-10.0 fl oz

**Active ingredient:** lambda-cyhalothrin + chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 21 for grain; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after last treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Total of 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products/a/year. Do not apply more than 18.0 fl oz/a after silk initiation or 10.0 fl oz/a after milk stage.

## Brigade 2EC

**Rate:** 2.1-6.4 fl oz

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application.

**Maximum rate:** 0.3 lb ai/a/season including PRE and PPI, at plant, plus foliar applications. Use of ultra low volume (ULV) application on corn is prohibited.

## Declare

**Rate:** 1.02-1.54 fl oz

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.06 lb ai/a (0.38 pt/a)/crop from at plant and foliar applications. Do not apply more than 0.03 lb ai (0.19 pt) after silk initiation or more than 0.015 lb ai (0.096 pt) after milk stage.

## Delta Gold 1.5EC

**Rate:** 1.5-1.9 fl oz

**Active ingredient:** deltamethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21 for grain or forage; Do not apply within 12 days of cutting or grazing field corn for forage.

**Maximum rate:** 8.1 fl oz/a (0.095 lb ai/a) on field corn in one growing season. Do not make more than 5 applications/a/season.

## Dimethoate

**Rate:** see label

**Active ingredient:** dimethoate

**IRAC code:** 1B

**Preharvest interval (days):** 28 for grain, 14 for

forage

**Maximum rate:** Maximum application rate 0.5 lb ai/a

*Do not apply to corn during pollen-shed period if bees are present. Workers are prohibited from entering treated area to perform detassling tasks for 4 days in non-arid areas and for 15 days in outdoor areas where average rainfall is less than 25 inches-year. Do not apply in tank-mixes with ALS herbicides.*

## Fanfare EC, 2 ECand ES

**Rate:** 2.1-6.4 fl oz/a

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of the last application

**Maximum rate:** Do not apply more than 0.3 lb ai (19.2 oz formulated)/a/season

## Fastac EC, SC

**Rate:** 2.7-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 for grain, 60 for forage

**Maximum rate:** 11.4 fl oz/a/season

## Hero

**Rate:** 4.0-10.3 fl oz

**Active ingredient:** zeta-cypermethrin, bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 for grain, 60 for forage; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of the last application.

**Maximum rate:** 10.3 oz or 0.10 lb ai/application; Do not apply more than 41.2 oz or 0.4 lb ai/a/season including at-plant and foliar applications. Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin to corn. Use of ultra low volume (ULV) application on corn is prohibited.

## Lannate LV

**Rate:** 0.75-1.5 pt

**Active ingredient:** methomyl

**IRAC code:** 1A

**Preharvest interval (days):** 21 for ears and stover, 3 for forage

**Maximum rate:** 7.5 pt/a/crop

*High acute toxicity to humans. Highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply or allow it to drift to blooming crops or weeds while bees are visiting the treatment area.*

## Lannate SP

**Rate:** 0.25-0.50 lb

**Active ingredient:** methomyl

**IRAC code:** 1A

**Preharvest interval (days):** 21 for ears and stover, 3 for forage

**Maximum rate:** 2.5 lb/a/crop

*High acute toxicity to humans. Highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply or allow it to drift to blooming crops or weeds while bees are visiting the treatment area.*

## Mustang Maxx

**Rate:** 2.72-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 7 for grain, stover and forage

**Maximum rate:** 16 oz/a or 0.10 lb ai/a/season.

## Paradigm

**Rate:** 2.56-3.84 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Do not apply more than 0.12 lb ai (0.96 pt)/a/crop from at-plant and foliar applications. Do not apply more than 0.06 lb ai (0.48 pt) after silk initiation. Do not apply more than 0.03 lb ai (0.24 pt) after corn has reached the milk stage (yellow kernel with milk fluid).

## Sevin XLR Plus

**Rate:** 1.0-2.0 qt

**Active ingredient:** carbaryl

**IRAC code:** 1A

**Preharvest interval (days):** 48 for grain and fodder, 14 for harvest or grazing of forage or silage

**Maximum rate:** 8 qt/a/crop/year

*Bee Precaution: Do not apply this product to target crops or weeds in bloom.*

## Silencer

**Rate:** 2.56-3.84 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21; Do not allow livestock to graze in treated areas or harvest treated

corn forage as feed for meat or dairy animals within 1 day after treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Do not apply more than 0.12 lb ai (0.96 pt)/a/crop from at-plant and foliar applications. Do not apply more than 0.06 lb ai (0.48 pt) after silk initiation. Do not apply more than 0.03 lb ai (0.24 pt) after corn has reached the milk stage (yellow kernel with milk fluid).

## Warrior II

**Rate:** 1.28-1.92 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.12 lb ai/a (7.68 fl oz or 0.48 pt/a)/crop from at plant and foliar applications; Apply 0.06 lb ai/a (3.84 fl oz or 0.24 pt/a) after silk initiation. Do not apply more than 0.03 lb ai/a (1.92 fl oz or 0.12 pt/a) after corn has reached the milk stage.

## Corn rootworm

**Threshold:** You will need to use a rootworm control tactic or rotate to a crop other than corn if you found an average of 0.75 beetles per plant during the previous corn crop year during the egg laying period.

## Aztec 4.67G

**Rate:** 3.0 oz/1,000 ft row

**Active ingredient:** tebufipirimphos, cyfluthrin

**IRAC code:** 1B, 3A

**Maximum rate:** 3.27 lb/a/season

## Aztec 4.67G SmartBox

**Rate:** 3.0 oz/1,000 ft row

**Active ingredient:** tebufipirimphos, cyfluthrin

**IRAC code:** 1B, 3A

**Maximum rate:** 7.3 lb/a/season Must be applied with the SmartBox system.

## Aztec HC

**Rate:** 1.5 oz/1,000 ft row

**Active ingredient:** tebufipirimphos, cyfluthrin

**IRAC code:** 1B, 3A

**Maximum rate:** 1.63 lb/a/season Must be applied with the SmartBox system.

## Bifenture LFC

**Rate:** 0.39-0.98 fl oz/1,000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** not listed

**Maximum rate:** 0.20 lb ai/a/season as an at-plant application; 0.3 lb ai/a/season including at-plant plus foliar applications of other bifenthrin products. Do not apply to soil where there is greater than 30% cover of crop residue remaining. Apply as a 5- to 7-in band (T-band) over an open furrow or in-furrow with the seed.

## Brigade 2EC

**Rate:** 0.3 fl oz/1,000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application

**Maximum rate:** 0.3 lb ai/a/season including PRE and PPI, at plant, plus foliar applications. Do not make aerial or ground applications to corn if heavy rainfall is imminent. Do not apply to soil where there is >30% cover of crop residue remaining. Use of ultra low volume (ULV) application on corn is prohibited. Apply as a 5- to 7-in band treatment over an open seed furrow. Do not apply more than 0.10 lb ai/a at planting.

## Capture LFR

**Rate:** 0.39-0.98 fl oz/1,000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** not listed

**Maximum rate:** 0.2lb ai/a/season as an at-plant application; 0.3 lb ai/a/season including at-plant plus foliar applications of other bifenthrin products (such as Brigade 2EC). Apply as a 5- to 7-in band (T-band) over an open furrow or in-furrow with the seed.

## Capture 3RIVE 3D

**Rate:** 0.46-0.92 fl oz/1000 row ft.

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Placement In-Furrow:** Apply only with Capture 3Rive 3D application equipment in furrow with seed.

**Maximum Rate:** Do not apply more than 0.2 lb ai/a as an at-plant application. Do not apply more than 0.3 lb ai/a including PPI, at-plant, preemergence and foliar applications of bifenthrin products

## Counter 20G (Lock'N Load, SmartBox, Smart Cartridge)

**Rate:** 4.5-6.0 oz/1,000 ft row

**Active ingredient:** terbufos

**IRAC code:** 1B

**Preharvest interval (days):** DO NOT graze or cut for forage within 30 days of treatment

**Maximum rate:** 6.5 lb/a; ALS-inhibiting herbicides SHOULD NOT be used if applied to corn at the time of planting.

## Cruiser 5 FS

**Rate:** 1.25 mg/seed

**Active ingredient:** thiamethoxam

**IRAC code:** 4A

*Do not use treated seed for feed, food or oil purposes.*

*Bee precaution: Highly toxic to bees, and effects are possible as a result of exposure to translocated residues in blooming crops.*

## Ethos XB

**Rate:** 0.39-0.98 fl. oz/1,000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** none listed

**Maximum rate:** Do not apply more than 0.2 lb bifenthrin active per acre per season as an at-plant application. Rates less than the equivalent of 8.0 fl oz/a at 30: row spacing may not provide adequate control of corn rootworm.

## Force 3G

**Rate:** 4.0-5.0 oz/1,000 ft row

**Active ingredient:** tefluthrin

**IRAC code:** 3A

**Maximum rate:** Do not exceed 10.9 oz/A per application regardless of row spacing. Do not apply unless you can incorporate the granules as directed on label. Do not follow an at-planting application with a lay-by application.

**Banded:** Place granules in a 7-in band directly behind the planter shoe in front of or behind the press wheel.

**In-furrow:** Place granules directly in the seed furrow behind the planter shoe.

## Force 6.5G

**Rate:** 1.8-2.3 oz/1,000 row feet

**Active ingredient:** tefluthrin

**IRAC code:** 3A

**Preharvest interval (days):** N/A

**Maximum rate:** 5.0 lbs/a (0.327 lbs/a of tefluthrin containing products)

## Force 10G HL

**Rate:** 1.25-1.5 oz/1,000 ft row

**Active ingredient:** tefluthrin

**IRAC code:** 3A

**Maximum rate:** 3.27 lb/a (0.327 tefluthrin containing products)

*Must be applied using Smart Box or SIMPAS system.*

*Do not apply unless you can incorporate the granules as directed on label. Do not follow an at-planting application with a lay-by application.*

## Force Evo

**Rate:** 0.46-0.57 fl oz/1,000 ft row

**Active ingredient:** tefluthrin

**IRAC code:** 3A

**Maximum rate:** 0.57 fl oz/1,000 ft row. Make one application/year

## Index

**Rate:** 0.65-0.72 fl oz/1,000 ft row

**Active ingredient:** chlorethoxyfos, bifenthrin

**IRAC code:** 1B, 3A

**Preharvest interval (days):** not listed

**Maximum rate:** row spacing dependant up to 17.8 fl oz/a.

Precaution: apply in-furrow at planting only. Do not make more than 1 application/year.

## Poncho 600

**Rate:** 1.25 mg clothianidin per seed

**Active ingredient:** clothianidin

**IRAC code:** 4A

**Maximum rate:** 1.25 mg/seed

*Do not use treated seed for food, feed, or oil processing. This compound is toxic to birds and mammals. Treated seeds exposed on soil surface may be hazardous to birds and mammals. Cover or collect treated seeds spilled during loading.*

## SmartChoice HC

**Rate:** 1.5-1.67 oz/1,000 ft row

**Active ingredient:** chlorethoxyfos, bifenthrin

**IRAC code:** 1A, 3A

**Preharvest interval (days):** not listed

**Maximum rate:** 1.67 oz/1000 rf

**Precautions:** apply in furrow only using SmartBox or SIMPAS application system.

*Sniper LFR*

**Rate:** 0.39-0.98 fl oz/1,000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** not listed

**Maximum rate:** 0.20 lb bifenthrin per a/season as an at-plant application; 0.3 lb ai/a/season including

at-plant plus foliar applications of other bifenthrin products. Do not apply to soil where there is greater than 30% cover of crop residue remaining. Apply as a 5- to 7-in band (T-band) over an open furrow or in-furrow with the seed.

## Cutworm

**Threshold:** Treat when 2-5% of plants show cutting activity.

### Asana XL

**Rate:** 5.8-9.6 fl oz

**Active ingredient:** esfenvalerate

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.25 lb ai/a/season

Apply at 3.2-9.6 fl oz/a for the control of black cutworm at planting of corn. Applications for cutworm control may be applied before, during, or after planting as required to protect emerging or emerged corn seedlings.

### Avicta Complete Corn

**Rate:** varies with formulation

**Active ingredient:** thiamethoxam, abamectin

**IRAC code:** 4A, 6

**Maximum rate:** varies with formulation

### Aztec 4.67G

**Rate:** 3.0 oz/1,000 ft row

**Active ingredient:** tebupirimphos, cyfluthrin

**IRAC code:** 1B, 3A

**Maximum rate:** 3.27 lb/a/season Optimum control of cutworm when applied as a band or T-band.

### Aztec 4.67G SmartBox

**Rate:** 3.0 oz/1,000 ft row

**Active ingredient:** tebupirimphos, cyfluthrin

**IRAC code:** 1B, 3A

**Maximum rate:** 3.27 lb ai/a/season Must be applied with the SmartBox system. Optimum control of cutworm when applied as a band or T-band.

### Aztec HC

**Rate:** 1.5 oz/1,000 ft row

**Active ingredient:** tebupirimphos, cyfluthrin

**IRAC code:** 1B, 3A

**Maximum rate:** 1.63 lb/a/season

Must be applied with the SmartBox system. Optimum control of cutworm when applied as a band or T-band.

### Baythroid XL

**Rate:** 0.8-1.6 fl oz

**Active ingredient:** beta-cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21 for grain or fodder, 0 for green forage

**Maximum rate:**

11.2 fl oz/a (0.088 lb ai/a)/season

### Besiege

**Rate:** 5.0-10.0 fl oz

**Active ingredient:** lambda-cyhalothrin + chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 21 for grain; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after last treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Total of 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products/a/year. Do not apply more than 18.0 fl oz/a after silk initiation or 10.0 fl oz/a after milk stage.

### Bifenture LFC

**Rate:** 0.2-0.78 fl oz/1,000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** not listed

**Maximum rate:** 0.20 lb ai/a/season as an at-plant application; 0.3 lb ai/a/season including at-plant plus foliar applications of other bifenthrin products. Do not apply to soil where there is greater than 30% cover of crop residue remaining. Apply as a 5- to 7-in band (T-band) over an open furrow or in-furrow with the seed.

### Brigade 2EC

**Rate:** 2.1-6.4 fl oz (foliar use only)

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application.

**Maximum rate:** 0.3 lb ai/a/season including PRE and PPI, at plant, plus foliar applications. Use of ultra low volume (ULV) application on corn is prohibited.

### Capture LFR

**Rate:** 0.2-0.78 fl oz/1,000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** not listed

**Maximum rate:** 0.1lb ai/a/season as an at-plant application; 0.3 lb ai/a/season including at-plant plus foliar applications of other bifenthrin products (such as Brigade 2EC). Do not apply to soil where there is greater than 30% cover of crop residue remaining. Apply as a 5- to 7-in band (T-band) over an open furrow or in-furrow with the seed.

### Capture 3RIVE 3D

**Rate:** 0.23-0.92 fl oz/1000 row ft.

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Placement: In-Furrow Comments:** Apply only with Capture 3Rive 3D application equipment in furrow with seed.

**Maximum Rate:** Do not apply more than 0.2 lb ai/a as an at-plant application. Do not apply more than 0.3 lb ai/a including PPI, at-plant, preemergence and foliar applications of bifenthrin products

### Coragen 1.67SC

**Rate:** 3.5-7.5 fl oz

**Active ingredient:** chlorantraniliprole

**IRAC code:** 28

**Preharvest interval (days):** 14

**Maximum rate:** 15.4 fl oz Coragen or 0.2 lb ai of chlorantraniliprole containing products/a/crop. Do not make more than 4 applications/a/crop.

### Cruiser 5 FS

**Rate:** 0.25-0.80 mg /seed

**Active ingredient:** thiamethoxam

**IRAC code:** 4A

**Maximum rate:** 0.25-0.80 mg/seed

*Precautions: Do not use treated seed for feed, food or oil purposes.*

*Bee precaution: Highly toxic to bees, and effects are possible as a result of exposure to translocated residues in blooming crops.*

### Declare

**Rate:** 0.77-1.28 fl oz

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.06 lb ai/a (0.38 pt/a)/crop from at plant and foliar applications. Do not apply more than 0.03 lb ai (0.19 pt) after silk initiation or more than 0.015 lb ai (0.096 pt) after milk stage.

### Delta Gold 1.5EC

**Rate:** 1.0-1.5 fl oz

**Active ingredient:** deltamethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21 for grain or fodder; Do not apply within 12 days of cutting or grazing field corn for forage.  
**Maximum rate:** 8.1 fl oz/a (0.095 lb ai/a) on field corn in one growing season. Do not make more than 5 applications/a/season.

### Ethos XB

**Rate:** 0.2-0.98 fl. oz/1,000 ft row  
**Active ingredient:** bifenthrin  
**IRAC code:** 3A  
**Preharvest interval (days):** none listed  
**Maximum rate:** Do not apply more than 0.2 lb bifenthrin active per acre per season as an at-plant application. Rates less than the equivalent of 8.0 fl oz/a at 30: row spacing may not provide adequate control of corn rootworm.

### Fanfare EC, 2 EC and ES

**Rate:** 2.1-6.4 fl oz/a  
**Active ingredient:** bifenthrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of the last application  
**Maximum rate:** Do not apply more than 0.3 lb active ingredient (19.2 oz formulated)/a/season.

### Fastac EC, SC

**Rate:** 1.3-2.8 fl oz  
**Active ingredient:** alpha-cypermethrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 30 for grain, 60 for forage  
**Maximum rate:** 11.4 fl oz/a/season

### Force 3G

**Rate:** 3.0-4.0 oz/1,000 ft row  
**Active ingredient:** tefluthrin  
**IRAC code:** 3A  
**Maximum rate:** Do not exceed 10.9 oz/A per application regardless of row spacing Do not apply unless you can incorporate the granules as directed on label. Do not follow an at-planting application with a lay-by application.  
**Banded:** Place granules in a 7-in band directly behind the planter shoe in front of or behind the press wheel.  
**In-furrow:** Place granules directly in the seed furrow behind the planter shoe.

### Force 6.5G

**Rate:** 1.8-2.3 oz/1,000 row feet (1.4-1.8 oz/1,000 row ft. on first year corn only)  
**Active ingredient:** tefluthrin  
**IRAC code:** 3A

**Preharvest interval (days):** N/A  
**Maximum rate:** 5.0 lbs/a (0.327 lbs/a of tefluthrin containing products)

### Force 10G HL

**Rate:** 1.0-1.25 oz/1,000 ft row  
**Active ingredient:** tefluthrin  
**IRAC code:** 3A  
**Maximum rate:** 3.27 lb/a (0.327 tefluthrin containing products)  
Must be applied using SmartBox system. Do not apply unless you can incorporate the granules as directed on label. Do not follow an at-planting application with a lay-by application.

### Force Evo

**Rate:** 0.46-0.57 fl oz/1,000 ft row  
**Active ingredient:** tefluthrin  
**IRAC code:** 3A  
**Maximum rate:** 0.57 fl oz/1,000 ft row. Make one application/year

### Hero

**Rate:** 2.6-6.1 fl oz  
**Active ingredient:** zeta-cypermethrin, bifenthrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 30 for grain, 60 for forage; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of the last application.  
**Maximum rate:** 10.3 oz or 0.10 lb ai/application. Do not apply more than 41.2 oz or 0.4 lb ai/a/season including at-plant and foliar applications. Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin to corn.  
Use of ultra low volume (ULV) application on corn is prohibited.

### Index

**Rate:** 0.65-0.72 fl oz/1,000 ft row  
**Active ingredient:** chlorethoxyfos, bifenthrin  
**IRAC code:** 1B, 3A  
**Preharvest interval (days):** not listed  
**Maximum rate:** row spacing dependant up to 17.8 fl oz/a.  
Precaution: apply in-furrow at planting only. Do not make more than 1 application/year.

### Lumivia seed treatment

**Rate:** 0.25-0.75 mg/seed  
**Active ingredient:** chlorantraniliprole  
**IRAC code:** 28  
**Preharvest interval (days):** not listed  
**Maximum rate:** 0.054 lb ai/a/season

*Do not use treated seed for food, feed or oil purposes. Following a Lumivia seed treatment, do not apply chlorantraniliprole or other group 28 products for approximately 60 days.*

### Mustang Maxx

**Rate:** 1.28-2.8 fl oz  
**Active ingredient:** zeta-cypermethrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 7 for grain, stover and forage  
**Maximum rate:** 16 oz/a or 0.10 lb ai/a/season

### Paradigm

**Rate:** 1.92-3.2 fl oz/a  
**Active ingredient:** lambda-cyhalothrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 21; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.  
**Maximum rate:** Do not apply more than 0.12 lb ai (0.96 pt)/a/crop from at-plant and foliar applications. Do not apply more than 0.06 lb ai (0.48 pt) after silk initiation. Do not apply more than 0.03 lb ai (0.24 pt) after corn has reached the milk stage (yellow kernel with milk fluid).

### Poncho 600

**Rate:** 0.25-0.50 mg/seed  
**Active ingredient:** clothianidin  
**IRAC code:** 4A  
**Maximum rate:** 0.25-0.50 mg/seed

*Do not use treated seed for food, feed, or oil processing. This compound is toxic to birds and mammals. Treated seeds exposed on soil surface may be hazardous to birds and mammals. Cover or collect treated seeds spilled during loading.*

### Poncho/Votivo

**Rate:** 0.25 – 0.50 mg ai/seed  
**Active ingredient:** clothianidin  
**IRAC code:** 4A  
**Maximum rate:** 0.50 mg ai/seed

*Do not use treated seed for food, feed, or oil processing. This compound is toxic to birds and mammals. Treated seeds exposed on soil surface may be hazardous to birds and mammals. Cover or collect treated seeds spilled during loading.*

### Sevin XLR Plus

**Rate:** 2.0 qt  
**Active ingredient:** carbaryl

**IRAC code:** 1A

**Preharvest interval (days):** 48 for grain and fodder; 14 for harvest or grazing of forage or silage

**Maximum rate:** 8 qt/a/crop/year

For best control on cutworm, apply in a 12-in band, over the row, using sufficient volume of water to obtain thorough coverage.

*Bee precaution: Do not apply this product to target crops or weeds in bloom.*

## Silencer

**Rate:** 1.92-3.2 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Do not apply more than 0.12 lb ai (0.96 pt)/a/crop from at-plant and foliar applications. Do not apply more than 0.06 lb ai (0.48 pt) after silk initiation. Do not apply more than 0.03 lb ai (0.24 pt) after corn has reached the milk stage (yellow kernel with milk fluid).

## SmartChoice HC

**Rate:** 1.0-1.67 oz/1,000 ft row

**Active ingredient:** tebupirimphos, cyfluthrin

**IRAC code:** 1B, 3A

**Preharvest interval (days):** not listed

**Maximum rate:** 1.67 oz/1000 row feet. Must be applied using Smart Box system

*Precautions: apply in furrow only*

## Sniper LFR

**Rate:** 0.2-0.39 fl oz/1,000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** not listed

**Maximum rate:** 0.20 lb bifenthrin/a/season as an at-plant application; 0.3 lb ai/a/season including at-plant plus foliar applications of other bifenthrin products. Do not apply to soil where there is greater than 30% cover of crop residue remaining. Apply as a 5- to 7-in band (T-band) over an open furrow or in-furrow with the seed.

## Warrior II

**Rate:** 0.96-1.6 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.12 lb ai/a (7.68 fl oz or

0.48 pt/a)/crop from at plant and foliar applications; Apply 0.06 lb ai/a (3.84 fl oz or 0.24 pt/a) after silk initiation. Do not apply more than 0.03 lb ai/a (1.92 fl oz or 0.12 pt/a) after corn has reached the milk stage.

## European corn borer

**Threshold:** see <https://learningstore.extension.wisc.edu/products/european-corn-borer-p153>

### Asana XL

**Rate:** 7.8-9.6 fl oz

**Active ingredient:** esfenvalerate

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.25 lb ai/a/season

**First generation:** Spray while eggs are in the blackhead stage or before the larvae enter the whorl.

**Second generation:** Make applications when sufficient egg masses are found and eggs are in the blackhead stage or starting to hatch.

### *Bacillus thuringiensis* several

**Rate:** see label (rates vary by formulation)

**Active ingredient:** *Bacillus thuringiensis*

**IRAC code:** 11

**Preharvest interval (days):** 0

**Maximum rate:** Several formulations available (see label)

*Apply while larvae are small.*

### Baythroid XL

**Rate:** 1.6-2.8 fl oz

**Active ingredient:** beta-cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21 for grain or fodder, 0 for green forage

**Maximum rate:** 11.2 fl oz/a (0.088 lb ai/a)/season

*Application must be made prior to the larvae boring into the plant.*

### Besiege

**Rate:** 6.0-10.0 fl oz

**Active ingredient:** lambda-cyhalothrin + chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 21 for grain; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after last treatment. Do not

feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Total of 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products/a/year. Do not apply more than 18.0 fl oz/a after silk initiation or 10.0 fl oz/a after milk stage.

*For control before European corn borer larvae bore into stalk/ear.*

## Brigade 2EC

**Rate:** 2.1-6.4 fl oz

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application.

**Maximum rate:** 0.3 lb ai/a/season including PRE and PPI, at plant, plus foliar applications. Use of ultra low volume (ULV) application on corn is prohibited.

## Coragen 1.67SC

**Rate:** 3.5-7.50 fl oz

**Active ingredient:** chlorantraniliprole

**IRAC code:** 28

**Preharvest interval (days):** 14

**Maximum rate:** 15.4 fl oz Coragen or 0.2 lb ai of chlorantraniliprole containing products/a/crop. Do not make more than 4 applications/a/crop.

## Declare

**Rate:** 1.02-1.54 fl oz

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.06 lb ai/a (0.38 pt/a) per crop from at plant and foliar applications. Do not apply more than 0.03 lb ai (0.19 pt) after silk initiation or more than 0.015 lb ai (0.096 pt) after milk stage.

*For control before larvae bore into stalk or ear.*

## Delta Gold 1.5EC

**Rate:** 1.5-1.9 fl oz

**Active ingredient:** deltamethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21 for grain or fodder. Do not apply within 12 days of cutting or grazing field corn for forage.

**Maximum rate:** 8.1 fl oz/a (0.095 lb ai/a) on field corn in one growing season. Do not make more than 5 applications/a/season.

*Apply to early instar larvae prior to boring into stalk or ear.*

---

## Fanfare EC, 2 EC and ES

**Rate:** 2.1-6.4 fl oz/a

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of the last application

**Maximum rate:** Do not apply more than 0.3 lb active ingredient (19.2 oz formulated)/a/season.

---

## Fastac EC, SC

**Rate:** 2.7-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 for grain, 60 for forage

**Maximum rate:** 11.4 fl oz/a/season

---

## Hero

**Rate:** 4.0-10.3 fl oz

**Active ingredient:** zeta-cypermethrin, bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 for grain, 60 for forage. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of the last application.

**Maximum rate:** 10.3 oz or 0.10 lb ai/application. Do not apply more than 41.2 oz or 0.4 lb ai/a/season including at-plant and foliar applications. Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin to corn.

Use of ultra low volume (ULV) application on corn is prohibited.

---

## Intrepid 2F

**Rate:** 4.0-16.0 fl oz

**Active ingredient:** methoxyfenozide

**IRAC code:** 18

**Preharvest interval (days):** 21 for grain

**Maximum rate:** 16 fl oz/a/application or more than a total of 64 fl oz/a (1 lb ai/a)/year

---

## Intrepid Edge

**Rate:** 4.0-12.0 fl oz

**Active ingredient:** methoxyfenozide, spinetoram

**IRAC code:** 18, 5

**Preharvest interval (days):** 28 for grain

**Maximum rate:** 12 fl oz/a/application or more than a total of 32 fl oz/a of Intrepid Edge (0.625 lb ai methoxyfenozide, 0.125 lb ai spinetoram)/a/year

---

## Lannate LV

**Rate:** 0.75-1.5 pt

**Active ingredient:** methomyl

**IRAC code:** 1A

**Preharvest interval (days):** 21 for ears and stover, 3 for forage

**Maximum rate:** 7.5 pt/a/crop

---

*High acute toxicity to humans. Highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply or allow it to drift to blooming crops or weeds while bees are visiting the treatment area.*

---

## Lannate SP

**Rate:** 0.25-0.50 lb

**Active ingredient:** methomyl

**IRAC code:** 1A

**Preharvest interval (days):** 21 for ears and stover, 3 for forage

**Maximum rate:** 2.5 lb/a/crop

---

*High acute toxicity to humans. Highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply or allow it to drift to blooming crops or weeds while bees are visiting the treatment area.*

---

## Mustang Maxx

**Rate:** 2.72-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 7 for grain, stover and forage

**Maximum rate:** 16 oz/a or 0.10 lb ai/a/season

---

## Paradigm

**Rate:** 2.56-3.84 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals with 1 day after treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Do not apply more than 0.12 lb ai (0.96 pt)/a/crop from at-plant and foliar applications. Do not apply more than 0.06 lb ai (0.48 pt) after silk initiation. Do not apply more than 0.03 lb ai (0.24 pt) after corn has reached the milk stage (yellow kernel with milk fluid).

---

## Prevathon

**Rate:** 14.0 - 20.0 fl oz./a

**Active ingredient:** chlorantraniliprole

**IRAC code:** 28

**Preharvest interval (days):** 14 for ears, 1 for forage, fodder, silage, stover

**Maximum rate:** 60 fl oz of chlorantraniliprole-

le-containing products/season, 4 applications/year

---

## Sevin XLR Plus

**Rate:** 1.5-2.0 qt

**Active ingredient:** carbaryl

**IRAC code:** 1A

**Preharvest interval (days):** 48 for grain and fodder, 14 for harvest or grazing of forage or silage

**Maximum rate:** 8 qt/a/crop/year

For best results on European corn borer, do not apply in less than 3 gal of water/a by air and 15 gal of water/a by ground.

---

*Bee precaution: Do not apply this product to target crops or weeds in bloom.*

---

## Silencer

**Rate:** 2.56-3.84 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Do not apply more than 0.12 lb ai (0.96 pt)/a/crop from at-plant and foliar applications. Do not apply more than 0.06 lb ai (0.48 pt) after silk initiation. Do not apply more than 0.03 lb ai (0.24 pt) after corn has reached the milk stage (yellow kernel with milk fluid).

---

## Tracer

**Rate:** 1.0-3.0 fl oz

**Active ingredient:** spinosad

**IRAC code:** 5

**Preharvest interval (days):** 28 for grain, 3 for forage or fodder

**Maximum rate:** 6 fl oz/a (0.188 lb ai/a)/year

---

## Warrior II

**Rate:** 1.28-1.92 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.12 lb ai/a (7.68 fl oz or 0.48 pt/a)/crop from at plant and foliar applications; Apply 0.06 lb ai/a (3.84 fl oz or 0.24 pt/a) after silk initiation. Do not apply more than 0.03 lb ai/a (1.92 fl oz or 0.12 pt/a) after corn has reached the milk stage.

---

*For control before the larvae bore into the plant stalk or ear.*

## Grasshopper

**Threshold:** Not established

### Asana XL

**Rate:** 5.8-9.6 fl oz

**Active ingredient:** esfenvalerate

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.25 lb ai/a/season; For first and second instar stages, 3.9-5.8 fl oz/a can be used.

Correct timing of spray applications and thorough coverage is critical to achieve optimum control. For later instars, use 5.8-9.6 fl oz/a.

### Baythroid XL

**Rate:** 2.1-2.8 fl oz

**Active ingredient:** beta-cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21 for grain or fodder, 0 for green forage

**Maximum rate:**

11.2 fl oz/a (0.088 lb ai/a)/season

### Besiege

**Rate:** 6.0-10.0 fl oz

**Active ingredient:** lambda-cyhalothrin + chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 21 for grain; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after last treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Total of 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products/a/year. Do not apply more than 18.0 fl oz/a after silk initiation or 10.0 fl oz/a after milk stage.

### Brigade 2EC

**Rate:** 2.1-6.4 fl oz

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application.

**Maximum rate:** 0.3 lb ai/a/season including PRE and PPI, at plant, plus foliar applications. Use of ultra low volume (ULV) application on corn is prohibited.

### Coragen 1.67SC

**Rate:** 2.0-5.0 fl oz

**Active ingredient:** chlorantraniliprole

**IRAC code:** 28

**Preharvest interval (days):** 14

**Maximum rate:** 15.4 fl oz Coragen or 0.2 lb ai of chlorantraniliprole containing products/a/crop. Do not make more than 4 applications/a/crop.

### Declare

**Rate:** 1.02-1.54 fl oz

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.06 lb ai/a (0.38 pt/a)/crop for at plant and foliar applications. Do not apply more than 0.03 lb ai (0.19 pt) after silk initiation or more than 0.015 lb ai (0.096 pt) after milk stage.

### Delta Gold 1.5EC

**Rate:** 1.0-1.5 fl oz

**Active ingredient:** deltamethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21 for grain or fodder; Do not apply within 12 days of cutting or grazing field corn for forage.

**Maximum rate:** 8.1 fl oz/a (0.095 lb ai/a) on field corn in one growing season. Do not make more than 5 applications/a/season.

### Dimethoate

several

**Rate:** See label (rate varies by formulation)

**Preharvest interval (days):** 28 for grain, 14 for forage

**Maximum rate:** 0.5 lb ai/a/application. Do not apply more than 0.5 lb ai/a/year. There are many different dimethoate formulations (see label).

*Workers are prohibited from entering the treated area to perform detasseling tasks for 4 days in nonarid areas and for 15 days in outdoor areas where the average annual rainfall is <25 inches per year.*

### Fanfare EC, 2 EC and ES

**Rate:** 2.1-6.4 fl oz/a

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of the last application.

**Maximum rate:** Do not apply more than 0.3 lb ai (19.2 oz formulated)/a/season.

### Fastac EC, SC

**Rate:** 2.7-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 for grain, 60 for forage

**Maximum rate:** 11.4 fl oz/a/season

### Hero

**Rate:** 2.6-6.1 fl oz

**Active ingredient:** zeta-cypermethrin, bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 for grain, 60 for forage; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of the last application.

**Maximum rate:** 10.3 oz or 0.10 lb ai/application; Do not apply more than 41.2 oz or 0.4 lb ai/a/season including at-plant and foliar applications. Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin to corn. Use of ultra low volume (ULV) application on corn is prohibited.

### Mustang Maxx

**Rate:** 2.72-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 7 for grain, stover and forage

**Maximum rate:** 16 oz/a or 0.10 lb ai/a/season

### Paradigm

**Rate:** 2.56-3.84 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Do not apply more than 0.12 lb ai (0.96 pt)/a/crop from at-plant and foliar applications. Do not apply more than 0.06 lb ai (0.48 pt) after silk initiation. Do not apply more than 0.03 lb ai (0.24 pt) after corn has reached the milk stage (yellow kernel with milk fluid).

### Prevathon

**Rate:** 8.0 - 20.0 fl oz./a

**Active ingredient:** chlorantraniliprole

**IRAC code:** 28

**Preharvest interval (days):** 14 for ears, 1 for forage, fodder, silage, stover

**Maximum rate:** 60 fl oz of chlorantraniliprole-containing products/season, 4 applications/year

### Silencer

**Rate:** 2.56-3.84 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Do not apply more than 0.12 lb ai (0.96 pt)/a/crop from at-plant and foliar applications. Do not apply more than 0.06 lb ai (0.48 pt) after silk initiation. Do not apply more than 0.03 lb ai (0.24 pt) after corn has reached the milk stage (yellow kernel with milk fluid).

## Warrior II

**Rate:** 1.28-1.92 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.12 lb ai/a (7.68 fl oz or 0.48 pt/a)/crop from at plant and foliar applications; Apply 0.06 lb ai/a (3.84 fl oz or 0.24 pt/a) after silk initiation. Do not apply more than 0.03 lb ai/a (1.92 fl oz or 0.12 pt/a) after corn has reached the milk stage.

## Hop vine borer

**Threshold:** Where yearly infestations occur along fence rows, waterways, or field margins, apply at plant emergence.

## Besiege

**Rate:** 6.0-10.0 fl oz

**Active ingredient:** lambda-cyhalothrin + chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 21 for grain; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after last treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Total of 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products/a/year. Do not apply more than 18.0 fl oz/a after silk initiation or 10.0 fl oz/a after milk stage.

*For control before the larvae bore into the plant stalk.*

## Declare

**Rate:** 1.02-1.54 fl oz

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.06 lb ai/a (0.38 pt/a) per crop

from at plant and foliar applications; Do not apply more than 0.03 lb ai (0.19 pt) after silk initiation or more than 0.015 lb ai (0.096 pt) after milk stage. For control before larvae bore into stalk.

## Fastac EC, SC

**Rate:** 2.7-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 for grain, 60 for forage

**Maximum rate:** 11.4 fl oz/a/season

## Hero

**Rate:** 2.6-6.1 fl oz

**Active ingredient:** zeta-cypermethrin, bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 for grain, 60 for forage; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of the last application.

**Maximum rate:** 10.3 oz or 0.10 lb ai/application; Do not apply more than 41.2 oz or 0.4 lb ai/a/season including at-plant and foliar applications. Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin to corn. Use of ultra low volume (ULV) application on corn is prohibited.

## Mustang Maxx

**Rate:** 2.72-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 7 for grain, stover and forage

**Maximum rate:** 16 oz/a or 0.10 lb ai/a/season

## Paradigm

**Rate:** 2.56-3.84 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Do not apply more than 0.12 lb ai (0.96 pt)/a/crop from at-plant and foliar applications. Do not apply more than 0.06 lb ai (0.48 pt) after silk initiation. Do not apply more than 0.03 lb ai (0.24 pt) after corn has reached the milk stage (yellow kernel with milk fluid).

## Silencer

**Rate:** 2.56-3.84 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals with 1 day after treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Do not apply more than 0.12 lb ai (0.96 pt)/a/crop from at-plant and foliar applications. Do not apply more than 0.06 lb ai (0.48 pt) after silk initiation. Do not apply more than 0.03 lb ai (0.24 pt) after corn has reached the milk stage (yellow kernel with milk fluid).

## Warrior II

**Rate:** 1.28-1.92 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.12 lb ai/a (7.68 fl oz or 0.48 pt/a)/crop from at plant and foliar applications; Apply 0.06 lb ai/a (3.84 fl oz or 0.24 pt/a) after silk initiation. Do not apply more than 0.03 lb ai/a (1.92 fl oz or 0.12 pt/a) after corn has reached the milk stage.

*For control before the larvae bore into the plant stalk.*

## Japanese beetle (adult)

**Threshold:** Consider a foliar insecticide treatment during tasseling and silking if there are three or more beetles per ear and silk clipping is occurring to within 0.5 inch.

## Asana XL

**Rate:** 5.8-9.6 fl oz

**Active ingredient:** esfenvalerate

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.25 lb ai/a/season

## Baythroid XL

**Rate:** 1.6-2.8 fl oz

**Active ingredient:** beta-cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21 for grain or fodder, 0 for green forage.

**Maximum rate:** 11.2 fl oz/a (0.088 lb ai/a)/season

## Besiege

**Rate:** 6.0-10.0 fl oz

**Active ingredient:** lambda-cyhalothrin +

chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 21 for grain; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after last treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Total of 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products/a/year. Do not apply more than 18.0 fl oz/a after silk initiation or 10.0 fl oz/a after milk stage.

## Brigade 2EC

**Rate:** 2.1-6.4 fl oz

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application.

**Maximum rate:** 0.3 lb ai/a/season including PRE and PPI, at plant, plus foliar applications. Use of ultra low volume (ULV) application on corn is prohibited.

## Declare 1.25CS

**Rate:** 1.02-1.54 fl oz

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.06 lb ai/a (0.38 pt/a)/crop from at plant and foliar applications; Do not apply more than 0.03 lb ai (0.19 pt) after silk initiation or more than 0.015 lb ai (0.096 pt) after milk stage.

## Delta Gold 1.5EC

**Rate:** 1.5-1.9 fl oz

**Active ingredient:** deltamethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21 for grain or fodder; Do not apply within 12 days of cutting or grazing field corn for forage.

**Maximum rate:** 8.1 fl oz/a (0.095 lb ai/a) on field corn in one growing season. Do not make more than 5 applications/a/season.

## Fanfare EC and ES

**Rate:** 2.1-6.4 fl oz/a

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of the last application.

**Maximum rate:** Do not apply more than 0.3 lb ai (19.2 oz formulated)/a/season.

## Fastac EC, SC

**Rate:** 2.7-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 for grain, 60 for forage

**Maximum rate:** 11.4 fl oz/a/season

## Hero

**Rate:** 4.0-10.3 fl oz

**Active ingredient:** zeta-cypermethrin, bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 for grain, 60 for forage; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of the last application.

**Maximum rate:** 10.3 oz or 0.10 lb ai/application; Do not apply more than 41.2 oz or 0.4 lb ai/a/season including at-plant and foliar applications. Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin to corn. Use of ultra low volume (ULV) application on corn is prohibited.

## Mustang Maxx

**Rate:** 2.72-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 7 for grain, stover and forage

**Maximum rate:** 16 oz/a or 0.10 lb ai/a/season

## Paradigm

**Rate:** 2.56-3.84 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Do not apply more than 0.12 lb ai (0.96 pt)/a/crop from at-plant and foliar applications. Do not apply more than 0.06 lb ai (0.48 pt) after silk initiation. Do not apply more than 0.03 lb ai (0.24 pt) after corn has reached the milk stage (yellow kernel with milk fluid).

## Sevin XLR Plus

**Rate:** 1.0-2.0 qt

**Active ingredient:** carbaryl

**IRAC code:** 1A

**Preharvest interval (days):** 48 for grain and fodder, 14 for harvest or grazing of forage or silage

**Maximum rate:** 8 qt/a/crop/year

*Bee Precaution: Do not apply this product to target crops or weeds in bloom.*

## Silencer

**Rate:** 2.56-3.84 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Do not apply more than 0.12 lb ai (0.96 pt)/a/crop from at-plant and foliar applications. Do not apply more than 0.06 lb ai (0.48 pt) after silk initiation. Do not apply more than 0.03 lb ai (0.24 pt) after corn has reached the milk stage (yellow kernel with milk fluid).

## Warrior II

**Rate:** 1.28-1.92 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.12 lb ai/a (7.68 fl oz or 0.48 pt/a)/crop from at plant and foliar applications; Apply 0.06 lb ai/a (3.84 fl oz or 0.24 pt/a) after silk initiation. Do not apply more than 0.03 lb ai/a (1.92 fl oz or 0.12 pt/a) after corn has reached the milk stage.

## Seedcorn maggot

**Threshold:** Not established

## Avicta Complete Corn

**Rate:** varies with formulation

**Active ingredient:** thiamethoxam, abamectin

**IRAC code:** 4A, 6

**Maximum rate:** varies with formulation

## Aztec 4.67G

**Rate:** 3.0 oz/1,000 ft row

**Active ingredient:** tebufipirimphos, cyfluthrin

**IRAC code:** 1B, 3A

**Maximum rate:** 3.27 lb/a/season. Optimum control is achieved when applied as a T-band or in-furrow.

## Aztec 4.67G SmartBox

**Rate:** 3.0 oz/1,000 ft row

**Active ingredient:** tebufipirimphos, cyfluthrin

**IRAC code:** 1B, 3A

**Maximum rate:** 3.27 lb/a/season Must be applied with the SIMPAS system. Optimum control is achieved when applied as a T-band or in-furrow.

### Aztec HC

**Rate:** 1.5 oz/1,000 ft row

**Active ingredient:** tebufos

**IRAC code:** 1B, 3A

**Maximum rate:** 1.63 lb ai/a/season Must be applied with the SmartBox system.

### Baythroid XL

**Rate:** 0.12-0.16 fl oz/1,000 ft row

**Active ingredient:** beta-cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21 for grain or fodder, 0 for forage

**Maximum rate:**

11.2 fl oz/a (0.088 lb ai/a)/season

### Bifenture LFC

**Rate:** 0.2-0.78 fl oz/1,000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):**

**Maximum rate:** 0.20 lb ai/a/season as an at-plant application; 0.3 lb ai/a/season including at-plant plus foliar applications of other bifenthrin products. Do not apply to soil where there is greater than 30% cover of crop residue remaining.

Apply as a 5- to 7-in band (T-band) over an open furrow or in-furrow with the seed.

### Brigade 2EC

**Rate:** 0.15-0.30 fl oz/1,000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application.

**Maximum rate:** 0.3 lb ai/a/season including PRE and PPI, at plant, plus foliar applications. Use of ultra low volume (ULV) application on corn is prohibited. In-furrow placement at planting for corn root worm larvae, seedcorn beetle, seedcorn maggot, white grub, and wireworm; foliar for all other labeled insects

### Capture LFR

**Rate:** 0.2-0.78 fl oz/1,000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Maximum rate:** 0.1 lb ai/a/season as an at-plant application; 0.3 lb ai/a/season including at-plant plus foliar applications of other bifenthrin products

(such as Brigade 2EC). Apply as a 5- to 7-in band (T-band) over an open furrow or in-furrow with the seed.

### Capture 3RIVE 3D

**Rate:** 0.23-0.92 fl oz/1000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Maximum Rate:** Do not apply more than 0.2 lb ai/a as an at-plant application. Do not apply more than 0.3 lb ai/a including PPI, at-plant, preemergence, and foliar applications of bifenthrin products.

**In-Furrow:** Apply only with Capture 3Rive 3D application equipment in furrow with seed.

### Counter 20G (Lock'NLoad, SmartBox, Smart Cartridge)

**Rate:** 4.5-6.0 oz/1,000 ft row

**Active ingredient:** terbufos

**IRAC code:** 1B

**Preharvest interval (days):** DO NOT graze or cut for forage within 30 days of treatment

**Maximum rate:** 6.5 lb/a; ALS-inhibiting herbicides SHOULD NOT be used if applied to corn at the time of planting.

### Cruiser 5 FS

**Rate:** 0.25-0.80 mg/seed

**Active ingredient:** thiamethoxam

**IRAC code:** 4A

**Maximum rate:** 0.25-0.80 mg/seed

*Precaution: Do not use treated seed for feed, food or oil purposes.*

*Bee precaution: Thiamethoxam is highly toxic to bees, and effects are possible as a result of exposure to translocated residues in blooming crops*

### Ethos XB

**Rate:** 0.2-0.98 fl. oz/1,000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** none listed

**Maximum rate:** Do not apply more than 0.3 lb bifenthrin active per acre per seas as an at-plant application. Rates less than the equivalent of 8.0 fl oz/a at 30: row spacing may not provide adequate control of corn rootworm

### Force 3G

**Rate:** 4.0-5.0 oz/1,000 ft row

**Active ingredient:** tefluthrin

**IRAC code:** 3A

**Maximum rate:** Do not exceed 10.9 oz/A per

application regardless of row spacing; Do not apply unless you can incorporate the granules as directed on label. Do not follow an at-planting application with a lay-by application.

**Banded:** Place granules in a 7-in band directly behind the planter shoe in front of or behind the press wheel.

**In-furrow:** Place granules directly in the seed furrow behind the planter shoe.

### Force 6.5G

**Rate:** 1.8-2.3 oz/1,000 row feet

**Active ingredient:** tefluthrin

**IRAC code:** 3A

**Preharvest interval (days):** N/A

**Maximum rate:** 5.0 lbs/a (0.327 lbs/a of tefluthrin containing products)

### Force Evo

**Rate:** 0.46-0.57 fl oz/1,000 ft row

**Active ingredient:** tefluthrin

**IRAC code:** 3A

**Maximum rate:** 0.57 fl oz/1,000 ft row. Make one application/year

### Force 10G HL

**Rate:** 1.25-1.5 oz/1,000 ft row

**Active ingredient:** tefluthrin

**IRAC code:** 3A

**Maximum rate:** 3.27 lb/a (0.327 tefluthrin containing products)

Must be applied with the SmartBox or SIMPAS application system. Do not apply unless you can incorporate the granules as directed on label. Do not follow an at-planting application with a lay-by application.

### Index

**Rate:** 0.65-0.72 fl oz/1,000 ft row

**Active ingredient:** chlorethoxyfos, bifenthrin

**IRAC code:** 1B, 3A

**Preharvest interval (days):** not listed

**Maximum rate:** row spacing dependant up to 17.8 fl oz/a.

*Precaution: apply in-furrow at planting only. Do not make more than 1 application/year.*

### Lumivia seed treatment

**Rate:** 0.25-0.75 mg/seed

**Active ingredient:** chlorantraniliprole

**IRAC code:** 28

**Preharvest interval (days):** not listed

**Maximum rate:** 0.054 lb ai/a/season

*Do not use treated seed for food, feed or oil purposes.*

Following a Lumivia seed treatment, do not apply chlorantraniliprole or other group 28 products for approximately 60 days.

### Poncho 600

**Rate:** 0.25-0.50 mg/seed  
**Active ingredient:** clothianidin  
**IRAC code:** 4A  
**Maximum rate:** 0.25-0.50 mg/seed

*Do not use treated seed for food, feed, or oil processing. This compound is toxic to birds and mammals. Treated seeds exposed on soil surface may be hazardous to birds and mammals. Cover or collect treated seeds spilled during loading.*

### SmartChoice HC

**Rate:** 1.5-1.67 oz/1000 row feet  
**Active ingredient:** chlorethoxyfos, bifenthrin  
**IRAC code:** 1B, 3A  
**Preharvest interval (days):** not listed  
**Maximum rate:** 1.67 oz/1000 rf

*Make 1 application/year. Apply in furrow only*

### Sniper LFR

**Rate:** 0.2-0.39 fl oz/1,000 ft row  
**Active ingredient:** bifenthrin  
**IRAC code:** 3A  
**Preharvest interval (days):** not listed  
**Maximum rate:** 0.20 lb bifenthrin/a/season as an at-plant application; 0.3 lb ai/a/season including at-plant plus foliar applications of other bifenthrin products. Do not apply to soil where there is greater than 30% cover of crop residue remaining. Apply as a 5- to 7-in band (T-band) over an open furrow or in-furrow with the seed.

### Slugs

**Threshold:** Not established

### Deadline Bullets

**Rate:** up to 25 lbs/a  
**Active ingredient:** metaldehyde  
**IRAC code:** n/a  
**Preharvest interval (days):** 0 days  
**Maximum rate:** 25 lbs/a/application, up to 3 applications/year

### Deadline GT

**Rate:** 33.3 lbs/a  
**Active ingredient:** metaldehyde  
**IRAC code:** n/a  
**Preharvest interval (days):** 0 days  
**Maximum rate:** 33.3 lbs/a/application, up to 3 application/season

### Deadline M-Ps

**Rate:** up to 25 lbs/a  
**Active ingredient:** metaldehyde  
**IRAC code:** n/a  
**Preharvest interval (days):** 0 days  
**Maximum rate:** 25 lbs/a/application, up to 3 applications/season

### Stalk borer

**Threshold:** Not established. When 1,300-1,400 degree days have accumulated, scout corn to verify that stalk borers are moving from grass to corn by looking for larvae inside the whorls. If an insecticide is needed, treat at 1,400-1,700 degree days.

### Asana XL

**Rate:** 5.8-9.6 fl oz  
**Active ingredient:** esfenvalerate  
**IRAC code:** 3A  
**Preharvest interval (days):** 21  
**Maximum rate:** 0.25 lb ai/a/season

*Application must be made early in migration from grassy areas to corn, before borers enter the plant.*

### Baythroid XL

**Rate:** 1.6-2.8 fl oz  
**Active ingredient:** beta-cyfluthrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 21 for grain or fodder, 0 for green forage  
**Maximum rate:** 11.2 fl oz/a (0.088 lb ai/a)/season

*Application must be made prior to the larvae boring into the plant.*

### Besiege

**Rate:** 6.0-10.0 fl oz  
**Active ingredient:** lambda-cyhalothrin + chlorantraniliprole  
**IRAC code:** 3A 28  
**Preharvest interval (days):** 21 grain; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after last treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.  
**Maximum rate:** Total of 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products/a/year. Do not apply more than 18.0 fl oz/a after silk initiation or 10.0 fl oz/a after milk stage.

*For control before larvae bore into the plant stalk.*

### Brigade 2EC

**Rate:** 2.1-6.4 fl oz  
**Active ingredient:** bifenthrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application.  
**Maximum rate:** 0.3 lb ai/a/season including PRE and PPI, at plant, plus foliar applications. Use of ultra low volume (ULV) application on corn is prohibited.

### Declare

**Rate:** 1.02-1.54 fl oz  
**Active ingredient:** gamma-cyhalothrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 21  
**Maximum rate:** 0.06 lb ai/a (0.38 pt/a)/crop from at plant and foliar applications. Do not apply more than 0.03 lb ai (0.19 pt) after silk initiation or more than 0.015 lb ai (0.096 pt) after milk stage.

*For control before larvae bore into the plant stalk.*

### Delta Gold 1.5EC

**Rate:** 1.5-1.9 fl oz  
**Active ingredient:** deltamethrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 21 for grain or fodder; Do not apply within 12 days of cutting or grazing field corn for forage.  
**Maximum rate:** 8.1 fl oz/a (0.095 lb ai/a) on field corn in one growing season. Do not make more than 5 applications/a/season.

*Apply to early instar larvae prior to boring into the stalk.*

### Fanfare EC, 2 EC and ES

**Rate:** 2.1-6.4 fl oz/a  
**Active ingredient:** bifenthrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of the last application  
**Maximum rate:** Do not apply more than 0.3 lb ai (19.2 oz formulated)/a/season.

### Fastac EC, SC

**Rate:** 2.7-3.8 fl oz  
**Active ingredient:** alpha-cypermethrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 30 for grain, 60 for forage  
**Maximum rate:** 11.4 fl oz/a/season

## Hero

**Rate:** 2.6-6.1 fl oz

**Active ingredient:** zeta-cypermethrin, bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 for grain, 60 for forage; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of the last application.

**Maximum rate:** 10.3 oz or 0.10 lb ai/application. Do not apply more than 41.2 oz or 0.4 lb ai/a/season including at-plant and foliar applications. Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin to corn. Use of ultra low volume (ULV) application on corn is prohibited.

## Mustang Maxx

**Rate:** 2.72-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 7 for grain, stover and forage

**Maximum rate:** 16 oz/a or 0.10 lb ai/a/season

## Paradigm

**Rate:** 2.56-3.84 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Do not apply more than 0.12 lb ai (0.96 pt)/a/crop from at-plant and foliar applications. Do not apply more than 0.06 lb ai (0.48 pt) after silk initiation. Do not apply more than 0.03 lb ai (0.24 pt) after corn has reached the milk stage (yellow kernel with milk fluid).

## Silencer

**Rate:** 2.56-3.84 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Do not apply more than 0.12 lb ai (0.96 pt)/a/crop from at-plant and foliar applications. Do not apply more than 0.06 lb ai (0.48 pt) after silk initiation. Do not apply more than 0.03 lb ai (0.24 pt) after corn has reached the

milk stage (yellow kernel with milk fluid).

## Warrior II

**Rate:** 1.28-1.92 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.12 lb ai/a (7.68 fl oz or 0.48 pt/a)/crop from at plant and foliar applications; Apply 0.06 lb ai/a (3.84 fl oz or 0.24 pt/a) after silk initiation. Do not apply more than 0.03 lb ai/a (1.92 fl oz or 0.12 pt/a) after corn has reached the milk stage.

*For control before the larvae bore into the plant stalk.*

## Two-spotted spider mite

**Threshold:** Not established. Control is suggested when the lower ¼ to ½ of the canopy is injured (live mites and stippled leaf damage), and corn has not dented. Effects on corn yield are more severe when mites damage leaves at or above the ear level.

## Brigade 2EC

**Rate:** 5.12-6.4 fl oz

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application.

**Maximum rate:** 0.3 lb ai/a/season including PRE and PPI, at plant, plus foliar applications. Use of ultra low volume (ULV) application on corn is prohibited.

## Comite

**Rate:** 32-48 fl oz/a

**Active ingredient:** Propargite

**IRAC code:** 12C

**Preharvest interval (days):** 30

**Maximum rate:** Do not make more than one application/season; Restricted Entry Interval is 13 days.

## Comite II

**Rate:** 18- 54 fl oz/a, variable by season

**Active ingredient:** Propargite

**IRAC code:** 12C

**Preharvest interval (days):** 30

**Maximum rate:** Do not make more than one application/season; Restricted Entry Interval is 13 days.

## Dimethoate (several)

**Rate:** See label (rate varies by formulation).

**Active ingredient:** dimethoate

**IRAC code:** 1B

**Preharvest interval (days):** 28 for grain, 14 for forage

**Maximum rate:** 0.5 lb ai/a/application; Do not apply more than 0.5 lb ai/a/year. There are many different dimethoate formulations (see label).

*Workers are prohibited from entering the treated area to perform detasseling tasks for 4 days in nonarid areas and for 15 days in outdoor areas where the average annual rainfall is less than 25 inches/year.*

## Fanfare EC, 2 EC and ES

**Rate:** 5.12-6.4 fl oz/a

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of the last application.

**Maximum rate:** Do not apply more than 0.3 lb ai (19.2 oz formulated)/a/season.

## Hero

**Rate:** 10.3 fl oz

**Active ingredient:** zeta-cypermethrin, bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 for grain, 60 for forage; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of the last application.

**Maximum rate:** 10.3 oz or 0.10 lb ai/application; Do not apply more than 41.2 oz or 0.4 lb ai/a/season including at-plant and foliar applications. Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin to corn. Use of ultra low volume (ULV) application on corn is prohibited.

## Oberon 25C

**Rate:** 5.7-16.0 fl oz

**Active ingredient:** spiromesifen

**IRAC code:** 23

**Preharvest interval (days):** 30 for grain or stover, 5 for green forage and silage

**Maximum rate:** 16.0 fl oz/ single applications, 2 applications/season 17.0 fl oz/a (0.27 lb ai/a), 12 month plant back restriction for soybean.

## Onager

**Rate:** 12-24.0 fl oz/a

**Active ingredient:** Hexythiazox

**IRAC code:** 5, 18

**Preharvest interval (days):** 30 (forage, stover, grain)

**Maximum rate:** 24.0 fl oz/acre/season

## Zeal SC

**Rate:** 2-6 fl oz/a

**Active ingredient:** Extoxazole

**IRAC code:** 10B

**Preharvest interval (days):** 21

**Maximum rate:** maximum of 2 applications/season; Do not apply more than 0.27 lb ai/a per calendar year, do not apply treatments less than 14 days apart.

## Zeal Miticide

**Rate:** 1.0-3.0 fl oz/a

**Active ingredient:** Extoxazole

**IRAC code:** 10B

**Preharvest interval (days):** 21

**Maximum rate:** maximum of 2 applications/season; Do not apply more than 0.27 lb ai/a per calendar year, do not apply treatments less than 14 days apart.

## Western bean cutworm

**Threshold:** For field corn, treat when 5% of plants sampled have egg masses and/or small larvae.

## Asana XL

**Rate:** 2.9-5.8 fl oz

**Active ingredient:** esfenvalerate

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.25 lb ai/a/season

*Apply before larvae enter the ear.*

## Baythroid XL

**Rate:** 1.6-2.8 fl oz

**Active ingredient:** beta-cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21 for grain or fodder, 0 for green forage

**Maximum rate:** 11.2 fl oz/a (0.088 lb ai/a)/season

*Apply before larvae enter the ear.*

## Besiege

**Rate:** 5.0-10.0 fl oz

**Active ingredient:** lambda-cyhalothrin + chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 21 grain; Do not

allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after last treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Total of 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin containing products or 0.2 lb ai of chlorantraniliprole containing products/a/year. Do not apply more than 18.0 fl oz/a after silk initiation or 10.0 fl oz/a after milk stage.

*For control before the larvae bore into the ear.*

## Brigade 2EC

**Rate:** 2.1-6.4 fl oz

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application.

**Maximum rate:** 0.3 lb ai/a/season including PRE and PPI, at plant, plus foliar applications. Use of ultra low volume (ULV) application on corn is prohibited.

## Coragen 1.67SC

**Rate:** 3.5-7.5 fl oz

**Active ingredient:** chlorantraniliprole

**IRAC code:** 28

**Preharvest interval (days):** 14

**Maximum rate:** 15.4 fl oz Coragen or 0.2 lb ai of chlorantraniliprole containing products/a/crop. Do not make more than 4 applications/a/crop.

## Declare

**Rate:** 0.77-1.28 fl oz

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.06 lb ai/a (0.38 pt/a)/crop from at plant and foliar applications. Do not apply more than 0.03 lb ai (0.19 pt) after silk initiation or more than 0.015 lb ai (0.096 pt) after milk stage.

*For control before larvae bore into the ear.*

## Fanfare EC, 2 EC and ES

**Rate:** 2.1-6.4 fl oz/a

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of the last application.

**Maximum rate:** Do not apply more than 0.3 lb ai (19.2 oz formulated)/a/season.

## Fastac EC, SC

**Rate:** 1.8-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 for grain, 60 for forage

**Maximum rate:** 11.4 fl oz/a/season

## Hero

**Rate:** 2.6-6.1 fl oz

**Active ingredient:** zeta-cypermethrin, bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 for grain, 60 for forage; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of the last application.

**Maximum rate:** 10.3 oz or 0.10 lb ai/application; Do not apply more than 41.2 oz or 0.4 lb ai/a/season including at-plant and foliar applications. Refer to the maximum usage tables when applying more than one product containing either zeta-cypermethrin or bifenthrin to corn. Use of ultra low volume (ULV) application on corn is prohibited.

## Intrepid 2F

**Rate:** 4.0-16.0 fl oz

**Active ingredient:** methoxyfenozide

**IRAC code:** 18

**Preharvest interval (days):** 21 for grain, 3 for ears and/or green chop (forage), 21 for dry fodder

**Maximum rate:** 16 fl oz/a/application or more than a total of 64 fl oz/a (1 lb ai/a)/year

## Intrepid Edge

**Rate:** 4.0-12.0 fl oz

**Active ingredient:** methoxyfenozide, spinetoram

**IRAC code:** 18, 5

**Preharvest interval (days):** 28 for grain

**Maximum rate:** 12 fl oz/a/application or more than a total of 32 fl oz/a of Intrepid Edge (0.625 lb ai methoxyfenozide, 0.125 lb ai spinetoram)/a/year

## Mustang Maxx

**Rate:** 1.76-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 7 for grain, stover and forage

**Maximum rate:** 16 oz/a or 0.10 lb ai/a/season

*For control before larvae bore into the ear.*

## Paradigm

**Rate:** 1.92-3.2 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Do not apply more than 0.12 lb ai (0.96 pt)/a/crop from at-plant and foliar applications. Do not apply more than 0.06 lb ai (0.48 pt) after silk initiation. Do not apply more than 0.03 lb ai (0.24 pt) after corn has reached the milk stage (yellow kernel with milk fluid).

### Prevathon

**Rate:** 14.0 - 20.0 fl oz./a

**Active ingredient:** chlorantraniliprole

**IRAC code:** 28

**Preharvest interval (days):** 14 for ears, 1 for forage, fodder, silage, stover

**Maximum rate:** 60 fl oz of iprole- containing products/season, 4 applications/year

### Sevin XLR Plus

**Rate:** 2.0 qt

**Active ingredient:** carbaryl

**IRAC code:** 1A

**Preharvest interval (days):** 48 for grain and fodder, 14 for harvest or grazing of forage or silage

**Maximum rate:** 8 qt/a/crop/year

*Bee Precaution: Do not apply this product to target crops or weeds in bloom.*

### Silencer

**Rate:** 1.92-3.20 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21; Do not allow livestock to graze in treated areas or harvest treated corn forage as feed for meat or dairy animals within 1 day after treatment. Do not feed treated corn fodder or silage to meat or dairy animals within 21 days after last treatment.

**Maximum rate:** Do not apply more than 0.12 lb ai (0.96 pt)/a/crop from at-plant and foliar applications. Do not apply more than 0.06 lb ai (0.48 pt) after silk initiation. Do not apply more than 0.03 lb ai (0.24 pt) after corn has reached the milk stage (yellow kernel with milk fluid).

### Tracer

**Rate:** 2.0-3.0 fl oz

**Active ingredient:** spinosad

**IRAC code:** 5

**Preharvest interval (days):** 28 for grain, 3 for forage or fodder

**Maximum rate:** 6 fl oz/a (0.188 lb ai/a)/year

### Tundra Supreme

**Rate:** 5.6-16.8 fl oz/a

**Active ingredient:** chlorpyrifos, bifenthrin

**IRAC code:** 1B, 3A

**Preharvest interval (days):** 30 for grain, do not graze treated fields for 30 days

**Maximum rate:** 50.5 fl oz/a per season

*Do not make more than 3 applications of any product containing chlorpyrifos per season. Do not make a second application of Tundra Supreme or other product containing chlorpyrifos within 10 days of first application. Do not tank mix with Steadfast or Lightning herbicides.*

### Warrior II

**Rate:** 0.96-1.6 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.12 lb ai/a (7.68 fl oz or 0.48 pt/a)/crop from at plant and foliar applications; Apply 0.06 lb ai/a (3.84 fl oz or 0.24 pt/a) after silk initiation. Do not apply more than 0.03 lb ai/a (1.92 fl oz or 0.12 pt/a) after corn has reached the milk stage.

*For control before the larva bores into the ear.*

### White grub

**Threshold:** Not established

### Avicta Complete Corn

**Rate:** varies with formulation

**Active ingredient:** thiamethoxam, abamectin

**IRAC code:** 4A, 6

**Maximum rate:** varies with formulation

### Aztec 4.67G

**Rate:** 3.0 oz/1,000 ft row

**Active ingredient:** tebupiriphos, cyfluthrin

**IRAC code:** 1B, 3A

**Maximum rate:** 3.27 lb/a/season . Optimum control of is achieved when applied as a T-band or in-furrow.

### Aztec 4.67G Smartbox

**Rate:** 3.0 oz/1,000 ft row

**Active ingredient:** tebupiriphos, cyfluthrin

**IRAC code:** 1B, 3A

**Maximum rate:** 3.27 lb/a/season Must be applied

with the SmartBox system. Optimum control of is achieved when applied as a T-band or in-furrow.

### Aztec HC

**Rate:** 1.5 oz/1,000 ft row

**Active ingredient:** tebupiriphos, cyfluthrin

**IRAC code:** 1B, 3A

**Preharvest interval (days):**

**Maximum rate:** 1.63 lb ai/a/season Must be applied with the SmartBox system. Optimum control of is achieved when applied as a T-band or in-furrow.

### Baythroid XL

**Rate:** 0.14-0.16 fl oz/1,000 ft row

**Active ingredient:** beta-cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 11.2 fl oz/a (0.088 lb ai/a)/season

### Bifenture LFC

**Rate:** 0.39-0.98 fl oz/1,000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** not listed

**Maximum rate:** 0.20 lb ai/a/season as an at-plant application; 0.3 lb ai/a/season including at-plant plus foliar applications of other bifenthrin products. Do not apply to soil where there is greater than 30% cover of crop residue remaining. Apply as a 5- to 7-in band (T-band) over an open furrow or in-furrow with the seed.

### Brigade 2EC

**Rate:** 0.15-0.30 fl oz/1,000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application.

**Maximum rate:** 0.3 lb ai/a/season including PRE and PPI, at plant, plus foliar applications. Do not apply to soil where there is greater than 30% cover of crop residue remaining. Use of ultra low volume (ULV) application on corn is prohibited. In-furrow placement at planting for corn root worm larvae, seedcorn beetle, seedcorn maggot, white grub, and wireworm; foliar for all other labeled insects

### Capture LFR

**Rate:** 0.2-0.78 fl oz/1,000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Maximum rate:** 0.1 lb ai/a/season as an at-plant application; 0.3 lb ai/a/season including at-plant plus foliar applications of other bifenthrin products (such as Brigade 2EC).

### Capture 3RIVE 3D

**Rate:** 0.23-0.92 fl oz/1000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Maximum Rate:** Do not apply more than 0.2 lb ai/a as an at-plant application. Do not apply more than 0.3 lb ai/a including PPI, at-plant, preemergence and foliar applications of bifenthrin products.

**In-Furrow:** Apply only with Capture 3Rive 3D application equipment in furrow with seed.

### Counter 20G (Lock'N Load, SmartBox, Smart Cartridge)

**Rate:** 4.5-6.0 oz/1,000 ft row

**Active ingredient:** terbufos

**IRAC code:** 1B

**Preharvest interval (days):** DO NOT graze or cut for forage within 30 days of treatment

**Maximum rate:** 6.5 lb/a; ALS-inhibiting herbicides SHOULD NOT be used if applied to corn at the time of planting.

### Cruiser 5 FS

**Rate:** 0.25-0.80 mg/seed

**Active ingredient:** thiamethoxam

**IRAC code:** 4A

**Preharvest interval (days):**

**Maximum rate:** 0.25-0.80 mg/seed

*Bee precaution: Thiamethoxam is highly toxic to bees, and effects are possible as a result of exposure to translocated residues in blooming crops.*

### Ethos XB

**Rate:** 0.2-0.98 fl. oz/1,000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Maximum rate:** Do not apply more than 0.3 lb bifenthrin active per acre per seas as an at-plant application. Rates less than the equivalent of 8.0 fl oz/a at 30: row spacing may not provide adequate control of corn rootworm.

### Force 3G

**Rate:** 4.0-5.0 oz/1,000 ft row

**Active ingredient:** tefluthrin

**IRAC code:** 3A

**Maximum rate:** Do not exceed 10.9 oz/A per application regardless of row spacing r; Do not apply unless you can incorporate the granules as directed on label. Do not follow an at-planting application

with a lay-by application.

**Banded:** Place granules in a 7-in band directly behind the planter shoe in front of or behind the press wheel.

**In-furrow:** For best results apply in-furrow. Place granules directly in the seed furrow behind the planter shoe. Use highest rate for heavy infestation.

### Force 6.5G

**Rate:** 1.8-2.3 oz/1,000 row feet

**Active ingredient:** tefluthrin

**IRAC code:** 3A

**Preharvest interval (days):** N/A

**Maximum rate:** 5.0 lbs/a (0.327 lbs/a of tefluthrin containing products)

### Force Evo

**Rate:** 0.46-0.57 fl oz/1,000 ft row

**Active ingredient:** tefluthrin

**IRAC code:** 3A

**Maximum rate:** 0.57 fl oz/1,000 ft row. Make one application/year

*For best results apply granules in furrow. For heavy infestations use highest rate*

### Force 10G HL

**Rate:** 1.25-1.5 oz/1,000 ft row

**Active ingredient:** tefluthrin

**IRAC code:** 3A

**Maximum rate:** 3.27 lb/a (0.327 tefluthrin containing products)

Must be applied with the SmartBox or SIMPAS application system. Do not apply unless you can incorporate the granules as directed on label. Do not follow an at-planting application with a lay-by application.

*For best control apply the granules as an in-furrow treatment. For heavy infestation use 1.5 oz/1000 rf.*

### Index

**Rate:** 0.65-0.72 fl oz. 1,000 ft row

**Active ingredient:** chlorethoxyfos, bifenthrin

**IRAC code:** 1B, 3A

**Preharvest interval (days):** not listed

**Maximum rate:** row spacing dependant up to 17.8 fl oz/a.

Precaution: apply in-furrow at planting only. Do not make more than 1 application/year.

### Lumivia seed treatment

**Rate:** 0.25-0.75 mg/seed

**Active ingredient:** chlorantraniliprole

**IRAC code:** 28

**Preharvest interval (days):** not listed

**Maximum rate:** 0.054 lb ai/a/season

*Do not use treated seed for food, feed or oil purposes. Following a Lumivia seed treatment, do not apply chlorantraniliprole or other group 28 products for approximately 60 days.*

### Poncho 600

**Rate:** 0.25-0.50 mg/seed

**Active ingredient:** clothianidin

**IRAC code:** 4A

**Maximum rate:** 0.25-0.50 mg/seed

*Do not use treated seed for food, feed, or oil processing. This compound is toxic to birds and mammals. Treated seeds exposed on soil surface may be hazardous to birds and mammals. Cover or collect treated seeds spilled during loading.*

### SmartChoice HC

**Rate:** 1.0-1.67 oz/1,000 ft row

**Active ingredient:** chlorethoxyfos, bifenthrin

**IRAC code:** 1B, 3A

**Preharvest interval (days):** not listed

**Maximum rate:** 1.67 oz/1000 row feet

*Apply in furrow only.*

### Sniper LFR

**Rate:** 0.2-0.39 fl oz/1,000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** not listed

**Maximum rate:** 0.20 lb bifenthrin/a/season as an at-plant application; 0.3 lb a/season including at-plant plus foliar applications of other bifenthrin products. Do not apply to soil where there is greater than 30% cover of crop residue remaining.

Apply as a 5- to 7-in band (T-band) over an open furrow or in-furrow with the seed.

### Tundra Supreme

**Rate:** 0.4- 0.8 fl oz/1000 ft row

**Active ingredient:** chlorpyrifos, bifenthrin

**IRAC code:** 1B, 3A

**Preharvest interval (days):** 30 for grain, do not graze treated fields for 35 days

**Maximum rate:** 16.84 fl oz/a per season of Tundra Supreme as an at plant application

### Wireworm

**Threshold:** Not established

### Avicta Complete Corn

**Rate:** rate varies with formulation

**Active ingredient:** thiamethoxam, abamectin

**IRAC code:** 4A, 6

**Maximum rate:** rate varies with formulation

### Aztec 4.67G

**Rate:** 3.0 oz/1,000 ft row

**Active ingredient:** tebufospyrimphos, cyfluthrin

**IRAC code:** 1B, 3A

**Maximum rate:** 3.27 lb/a/season. Optimum control of wireworms achieved when applied as a T-band or in-furrow.

### Aztec 4.67G SmartBox

**Rate:** 3.0 oz/1,000 ft row

**Active ingredient:** tebufospyrimphos, cyfluthrin

**IRAC code:** 1B, 3A

**Maximum rate:** 3.27 lb/a/season Must be applied with the SmartBox system. Optimum control of wireworms achieved when applied as a T-band or in-furrow.

### Aztec HC

**Rate:** 1.5 oz/1,000 ft row

**Active ingredient:** tebufospyrimphos, cyfluthrin

**IRAC code:** 1B, 3A

**Maximum rate:** 1.63 lb/a/season Must be applied with the SIMPAS system.

### Baythroid XL

**Rate:** 0.12-0.16 fl oz/1,000 ft row

**Active ingredient:** beta-cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21 for grain or fodder, 0 for green forage

**Maximum rate:**

11.2 fl oz/a (0.088 lb ai/a)/season

### Bifenture LFC

**Rate:** 0.2-0.78 fl oz/1,000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** not listed

**Maximum rate:** 0.20 lb ai/a/season as an at-plant application; 0.3 lb ai/a/season including at-plant plus foliar applications of other bifenthrin products. Do not apply to soil where there is greater than 30% cover of crop residue remaining.

Apply as a 5- to 7-in band (T-band) over an open furrow or in-furrow with the seed.

### Brigade 2EC

**Rate:** 0.15-0.30 fl oz/1,000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze

livestock in treated areas or cut treated crops for feed within 30 days of last application.

**Maximum rate:** 0.3 lb ai/a/season including PRE and PPI, at plant, plus foliar applications.

Do not apply to soil where there is greater than 30% cover of crop residue remaining. Use of ultra low volume (ULV) application on corn is prohibited. In-furrow placement at planting for corn rootworm larvae, seedcorn beetle, seedcorn maggot, white grub, and wireworm; foliar for all other labeled insects.

### Capture LFR

**Rate:** 0.2-0.78 fl oz/1,000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Maximum rate:** 0.1 lb ai/a/season as an at-plant application; 0.3 lb ai/a/season including at-plant plus foliar applications of other bifenthrin products (such as Brigade 2EC). Apply as a 5- to 7-in band (T-band) over an open furrow, or in-furrow with the seed.

### Capture 3RIVE 3D

**Rate:** 0.23-0.92 fl oz/1000 row ft.

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):**

**Maximum rate:** Do not apply more than 0.2 lb ai/a as an at-plant application. Do not apply more than 0.3 lb ai/a including PPI, at-plant, preemergence and foliar applications of bifenthrin products.

**In-Furrow:** Apply only with Capture 3Rive 3D application equipment in furrow with seed.

### Counter 20G (Lock'N Load, SmartBox, Smart Cartridge)

**Rate:** 4.5-6.0 oz/1,000 ft row

**Active ingredient:** terbufos

**IRAC code:** 1B

**Preharvest interval (days):** DO NOT graze or cut for forage within 30 days of treatment

**Maximum rate:** 6.5 lb/a; ALS-inhibiting herbicides SHOULD NOT be used if applied to corn at the time of planting.

### Cruiser 5 FS

**Rate:** 0.25-0.80 mg/seed

**Active ingredient:** thiamethoxam

**IRAC code:** 4A

**Maximum rate:** 0.25-0.80 mg/seed

*Bee precaution: Thiamethoxam is highly toxic to bees, and effects are possible as a result of exposure to translocated residues in blooming crops.*

### Ethos XB

**Rate:** 0.2-0.98 fl. oz/1,000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** none listed

**Maximum rate:** Do not apply more than 0.3 lb bifenthrin active per acre per seas as an at-plant application. Rates less than the equivalent of 8.0 fl oz/a at 30: row spacing may not provide adequate control of corn rootworm.

### Force 3G

**Rate:** 4.0-5.0 oz/1,000 ft row

**Active ingredient:** tefluthrin

**IRAC code:** 3A

**Maximum rate:** Do not exceed 10.9 oz/A per application regardless of row spacing ; Do not apply unless you can incorporate the granules as directed on label. Do not follow an at-planting application with a lay-by application.

**Banded:** Place granules in a 7-in band directly behind the planter shoe in front of or behind the press wheel.

**In-furrow:** For best results apply in-furrow. Place granules directly in the seed furrow behind the planter shoe. Use highest rate for heavy infestation

### Force 6.5G

**Rate:** 1.8-2.3 oz/1,000 row feet

**Active ingredient:** tefluthrin

**IRAC code:** 3A

**Preharvest interval (days):** N/A

**Maximum rate:** 5.0 lbs/a (0.327 lbs/a of tefluthrin containing products)

### Force 10G HL

**Rate:** 1.25-1.5 oz/1,000 ft row

**Active ingredient:** tefluthrin

**IRAC code:** 3A

**Maximum rate:** 3.27 lb/a (0.327 tefluthrin containing products)

Do not apply unless you can incorporate the granules as directed on label. Do not follow an at-planting application with a lay-by application.

*For best control apply the granules as an in-furrow treatment. For heavy infestation use 1.5 oz/1000 rf.*

### Force Evo

**Rate:** 0.46-0.57 fl oz/1,000 ft row

**Active ingredient:** tefluthrin

**IRAC code:** 3A

**Maximum rate:** 0.57 fl oz/1,000 ft row. Make one application/year

---

## Index

**Rate:** 0.65-0.72 fl oz/1,000 ft row

**Active ingredient:** chlorethoxyfos, bifenthrin

**IRAC code:** 1B, 3A

**Preharvest interval (days):** not listed

**Maximum rate:** row spacing dependant up to 17.8 fl oz/a.

Precaution: apply in-furrow at planting only. Do not make more than 1 application/year.

---

## Lumivia seed treatment

**Rate:** 0.25-0.75 mg/seed

**Active ingredient:** chlorantraniliprole

**IRAC code:** 28

**Preharvest interval (days):** not listed

**Maximum rate:** 0.054 lb ai/a/season

*Do not use treated seed for food, feed or oil purposes. Following a Lumivia seed treatment, do not apply chlorantraniliprole or other group 28 products for approximately 60 days.*

---

## Poncho 600

**Rate:** 0.25-0.50 mg/seed

**Active ingredient:** clothianidin

**IRAC code:** 4A

**Maximum rate:** 0.25-0.50 mg/seed

*Do not use treated seed for food, feed, or oil processing. This compound is toxic to birds and mammals. Treated seeds exposed on soil surface may be hazardous to birds and mammals. Cover or collect treated seeds spilled during loading.*

---

## SmartChoice HC

**Rate:** 1.5-1.67 oz/1000 row feet

**Active ingredient:** chlorethoxyfos, bifenthrin

**IRAC code:** 1B, 3A

**Preharvest interval (days):** not listed

**Maximum rate:** 1.67 oz/1000 row feet

*Make 1 application/year. Apply in furrow only*

---

## Sniper LFR

**Rate:** 0.2-0.39 fl oz/1,000 ft row

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** not listed

**Maximum rate:** 0.20 lb bifenthrin/a/season as an at-plant application; 0.3 lb a/season including at-plant plus foliar applications of other bifenthrin products. Do not apply to soil where there is greater than 30% cover of crop residue remaining.

Apply as a 5- to 7-in band (T-band) over an open furrow or in-furrow with the seed.

---

## Tundra Supreme

**Rate:** 0.4- 0.8 fl oz/1000 ft row

**Active ingredient:** chlorpyrifos, bifenthrin

**IRAC code:** 1B, 3A

**Preharvest interval (days):** 30 for grain, do not graze treated fields for 35 days

**Maximum rate:** 16.84 fl oz/a per season of Tundra Supreme as an at plant application

# Corn disease management

Corn diseases, like those of other crops, vary in severity from year to year and from one location or field to another. There are many factors that influence disease development, including environmental conditions, the resistance of the corn hybrid, and the population density of the disease organisms that are present. Thus, it is important for growers to distinguish when poor crop development is due to diseases, and when insect, nutrient deficiencies, soil conditions, herbicide injury, or weather conditions are the problem.

## Disease management strategies

Corn diseases can be managed by planting resistant or tolerant corn hybrids, rotating crops, using appropriate cultural practices, and applying pesticides. Although a single control procedure can be effective, a sound disease control program integrates all of these crop management techniques.

### Resistant hybrids

Selecting corn hybrids that are resistant or tolerant to major corn diseases is the foundation of any integrated disease control program. Your seed dealer should be a good source of information on specific hybrid reaction to disease. Terms describing hybrid reaction to disease are somewhat confusing. "Disease-resistant hybrids" should be regarded only as a general term that suggests resistance to specific diseases; it cannot be an all-inclusive statement, since no hybrid is resistant to all corn diseases. Also, hybrids are not described as being resistant/tolerant to a specific disease. Rather, leaf health, seedling cold tolerance, root size, and stalk strength

are characterized, but each relate to reactions to plant pathogens.

Many hybrids have good resistance to eyespot, Gibberella ear rot, northern corn leaf blight, northern leaf spot, rust, tar spot, and stalk rot. If you have had a history of problems with one or more of these diseases, ask about hybrid reactions to these specific diseases and choose hybrids with the best resistance to that problem disease.

Resistance does not mean immunity or complete freedom from infection or disease development. A resistant hybrid should withstand damage but may show some disease development when conditions favor the disease but not suffer much yield reduction. In other words, there is a gradation among hybrids ranging from susceptible to resistant to highly resistant to disease. Changes in cultural practices, new forms (races) of known pathogens, and new pathogens can result in disease in hybrids that were thought resistant.

Learn to identify the major diseases of corn and evaluate disease reactions of the hybrids you grow. Disease reactions of various hybrids can differ with each farm or locality because of different local weather conditions, tillage operations, soil type, and soil fertility. Consult local hybrid testing trials and data from those trials to assist you in choosing hybrids with the best disease resistance package that also grows and yields well in your location.

### Crop rotation and tillage practices

Crop rotation and tillage are effective disease control procedures. In many cases, the fungi that cause corn diseases overwinter in stalks, leaves, and roots. Once this corn debris is thoroughly decayed, many corn pathogens perish or are greatly reduced in numbers. Therefore, crop rotation and

tillage programs that allow residue decay in the field before the next corn crop is grown will help reduce diseases, especially leaf, seedling, and stalk diseases.

We support the concept of no-till or minimum tillage for crop production because of its soil-conserving potential. However, growers using no-till or minimum tillage should be alert for an increase in crop pest problems; the potential is greater for disease problems with reduced tillage than with conventional tillage systems. The risk of increased corn disease problems is even higher when reduced tillage is associated with continuous corn planting, the use of susceptible hybrids, and climatic conditions favorable for disease development. Corn hybrids that perform well in conventional tillage systems may decline in performance if grown in no-till systems.

Minimum tillage can affect root rot and stalk rot development in at least two ways: first, the associated pathogens become concentrated in the upper root zone (with conventional plowing they are distributed and thus diluted to a greater depth in the soil), and second, potassium may be less available to plants under a reduced tillage situation. You may need to supplement potassium to prevent a nitrogen-potassium (N:K) imbalance and subsequent stalk-rot problems.

Certain diseases are more prevalent if debris from the previous year's corn crop is left on the surface during wet seasons. Northern leaf spot, eyespot, and Gibberella ear rot are examples.

If you are considering continuous, reduced tillage, or no-till corn production, we suggest the following guidelines to minimize the risk of corn diseases:

- Select corn hybrids with resistance or tolerance to major leaf diseases.

- Select hybrids tolerant to stalk and ear rot.
- Consider chopping stalks in the fall. Many corn pathogens do not survive as well when the debris is close to the soil.
- Examine fields periodically during the growing season to spot any sign of disease development. Early harvest can minimize losses if disease severity is high.
- Consider crop rotation to help curb the buildup of corn pathogens that may be developing.
- Select corn hybrids rated superior for seedling cold tolerance.
- Consider planting corn seed treated with a fungicide.

### Seed protectants

Chemicals registered for protecting corn seed against seedling rot include captan, fludioxonil (Maxim), mefenoxam (Apron), pyraclostrobin (Stamina), metalaxyl, and mancozeb (check the labels to be sure chemicals include corn seed treatment), but other fungicides can be applied in the planter box. For a complete list, consult the *What's on Your Seed?* publication available at [ipcm.wisc.edu/downloads/pest-management](http://ipcm.wisc.edu/downloads/pest-management). Treatment is especially beneficial when seed vigor is low and during cold, wet spring weather. Virtually all corn seed on the market today is already treated with a fungicide. Many hybrid seed corn companies have changed from captan to Maxim or Maxim-Apron. Some companies take specific requests so you can tailor seed treatments to field conditions. For example, the use of trifloxystrobin (Trilex) in addition to the Maxim-Apron combination offers good protection if planting in cool, wet soils with a high risk of Pythium seed rot.

### Leaf disease control with fungicides

Foliar fungicides (Table 2-10) can effectively reduce severity of northern corn leaf blight, northern leaf spot, eyespot, gray leaf spot, and rust. It is

rarely economical for commercial corn producers to use fungicides for leaf disease control, unless diseases are active between tasseling through the milk growth stage on susceptible hybrids. However, seed corn producers often need to control these diseases because inbreds can be very susceptible to them.

Should any of these leaf diseases threaten during the period between tasseling and the milk growth stage, treatment may be economical. Early detection is critical; monitor fields of susceptible hybrids/inbreds weekly.

Check the label for specific limitations on the amount of product that can be used per acre per season, the preharvest interval, growth stage limitations, and feeding restrictions. For example, chlorothalonil (Bravo formulations) is registered for Helminthosporium leaf blights (northern corn leaf blight, northern leaf spot, southern leaf blight) and rust on fresh market sweet corn and corn grown for seed. Bravo is not labeled for use on processing sweet corn. Corn treated with Bravo cannot be fed to livestock, ensiled, or used as livestock forage. Label instructions must be followed carefully for effective use.

Consider the following factors before deciding to apply a foliar fungicide:

- The susceptibility of the inbred/hybrid to the disease(s) that threaten it.
- Timing of planting. Late planted corn is often at higher risk of yield-reducing disease epidemics.
- The anticipated time of disease development and severity. Severe leaf disease development usually occurs post tassel. Consequently, wet weather or continued heavy dews signal possible blight problems on fields already showing modest leaf spotting. If the blight already has invaded much of the leaf surface above the ear, the treatment benefits will be minimal.
- Treatment cost versus expected benefit. Each treatment costs

about \$20 to \$30/a for the chemical, wetting agent, and application.

## Disease problems

### Seed rot and seedling blights

Fungicide seed protectants generally control or minimize seed rot and seedling blights of corn. However, seed rot and seedling blight can be expected if corn is planted in wet and cool soils. Hybrids that have good seedling vigor are generally less susceptible to seed rot and seedling blights. Watch for reduced stands and stunted or dying seedlings. Often infected seedlings may develop into a mature plant, but the same disease organisms can cause root rot and stalk rot later on. Because injury from herbicides, insecticides, starter fertilizer, and soil insects can cause similar symptoms and results, accurate diagnosis is important.

### Leaf diseases

Leaf diseases vary in prevalence and severity from year to year and from one locality to another, depending largely on environmental conditions. Humid weather, along with heavy dew, favors the spread and development of leaf diseases caused by fungi. Leaf diseases can be found on corn grown in poor and rich soils; soil fertility does not seem to affect these diseases as much as weather conditions, the genetic makeup of a hybrid, and tillage practices. More leaf disease can be expected when no-till or minimum tillage in continuous cornfields is employed. Growers using overhead irrigation should be more watchful for leaf disease development. Leaf diseases are found especially in fields located in valleys and in lowland areas along streams and rivers. These field locations can have prolonged periods of high relative humidity and low or moderate temperatures that favor most leaf diseases of corn. If it is necessary for you to plant hybrids susceptible to leaf diseases, only plant them in upland fields with good air drainage, where corn debris from the previous crop has been thoroughly

**Table 2-10.** Fungicide efficacy for leaf diseases of field corn (hybrid seed production and grain)

Fungicide	Anthraco-nose	Eyespot	Gray leaf spot	Northern corn leaf blight	Northern corn leaf spot	Physoderma brown spot	Rust	Southern rust	Tar Spot	Active ingredient(s)	Chemical family (FRAC code <sup>a</sup> )	Amount/use/a	Preharvest interval (PHI)
Adastrio	x	x	x	x	x	x	x	8	x	Azoxystrobin + fluindipyr + flutriafol	Qol (11) + carboximides (7) + triazole (3)	7-9 fl oz	<b>Forage:</b> 7 days <b>Stover and Grain:</b> 30 days <b>Sweet corn:</b> 14 days
Remarks: Do not apply more than two (2) sequential applications. Do not apply more than 18 fl oz of product per acre per year.													
Affiance	x	x	7	7	x	-	7	6	2ee	tetraconazole + azoxystrobin	triazole (3) + Qol (11)	10 – 17 fl oz	7 days; do not apply within 21 days of silage harvest
Remarks: Do not make more than two (2) sequential applications per year. Do not apply more than 17.06 fl oz of affiance per acre per year.													
AfterShock	x	x	x	x	x	-	x	x	-	fluoxastrobin	Qol (11)	2–8 fl oz	30 days; do not apply after R4
Remarks: Do not apply more than two applications per season or more than 11.4 fl oz/a/year.													
Approach	8	8	5	8	x	x	9	x	-	picoxystrobin	Qol (11)	3–12 fl oz	7 days for grain; 0 days for forage
Remarks: Do not make more than two sequential applications before switching to a fungicide with a different mode of action. Do not tank mix with an adjuvant or crop oil when spraying corn between the V8 and VT stages of growth. Do not exceed 36 fl oz/a/crop.													
Approach Prima	x	x	10	8	x	x	8	6	2ee	picoxystrobin + cyproconazole	Qol (11) + triazole (3)	3.4–6.8 fl oz	30 days for grain and ear, 21 days for silage
Remarks: Do not apply more than 6.8 fl oz/a/year. Do not apply more than two sequential application of fungicide products containing a Qol (11) component. Do not use an adjuvant or crop oil after the V8 growth stage or before the VT growth stage as stress or injury can occur.													
Avaris	8	9	10	8	x	-	9	8	-	azoxystrobin + propiconazole	triazole (3) + Qol (11)	7–14 fl oz	30 days
Remarks: Do not apply more than 56 fl oz/a/season. Do not apply more than 28 fl oz/a for field corn harvested for forage. Do not apply more than 0.45 lb ai/a propiconazole-containing products or more than 2.0 lb ai/a azoxystrobin-containing products/season.													
Bravo Weather Stik	-	-	-	x	x	-	x	x	-	chlorothalonil	chloronitriles (M5)	0.75–2.0 pt	14 days
Remarks: Use only on corn grown for seed. Consult the label for disease-specific recommendations and rates. Do not apply more than 12 pt/a per season.													
Bumper 41.8 EC Bumper ES	-	-	-	-	-	-	x	x	-	propiconazole	triazole (3)	2–4 fl oz	30 days for forage, grain, and stover
Remarks: Consult the product label for disease-specific recommendations and rates. Do not apply more than 16 fl oz/a/season. Do not apply more than 8 fl oz/a/season on field corn harvested for forage. Do not apply more than 0.45 lb ai propiconazole/a/season.													

Efficacy ratings: Excellent = 10; very good = 8; good = 6; fair = 4; poor = 2; no control = 0; labeled, no data = x; not labeled = -; 2ee = Special FIFRA 2(ee) label, check current label status <sup>a</sup> Fungicide group numbers indicate the modes of action; multiple applications of fungicides with the same group number increases the chances for disease resistance.

Continued on next page

**Table 2-10.** Fungicide efficacy for leaf diseases of field corn (hybrid seed production and grain) (continued)

Fungicide	Anthracnose	Eyespot	Gray leaf spot	Northern corn leaf blight	Northern corn leaf spot	Physoderma brown spot	Rust	Southern rust	Tar Spot	Active ingredient(s)	Chemical family (FRAC code <sup>a</sup> )	Amount/ use/a	Preharvest interval (PHI)
Custodia	8	8	10	6	x	x	10	10	-	azoxystrobin + tebuconazole	Qol (11) + triazole (3)	9-12.9 fl oz	36 days for grain or fodder; 21 days for forage
<b>Remarks:</b> Do not use adjuvants or crop oil after V8 stage or before VT stage. Do not apply more than 51.7 fl oz/a/season. Do not apply more than 0.675 lb. a.i. tebuconazole-containing products/A/season. Do not apply more than 2.0 lb. a.i. azoxystrobin-containing products/A/season.													
Delaro	8	8	10	8	x	x	10	7	2ee	trifloxystrobin + prothioconazole	Qol (11) + triazole (3)	4.0 – 12 fl oz	14 days
<b>Remarks:</b> Do not apply more than 24 fl oz of Delaro fungicide per acre per year. Do not apply Delaro if corn is under stress. Do not use an adjuvant with Delaro when corn is between the V8 and VT growth stages.													
Delaro Complete	x	x	10	8	x	x	x	7	8	prothioconazole + trifloxystrobin + fluopyram	triazole (3) + Qol (11) + carboximides (7)	4.0 – 12.0 fl oz	14 days
<b>Remarks:</b> Do not apply more than 24 fl oz of Delaro Complete fungicide per acre per year. Do not apply Delaro Complete if corn is under stress. Do not use an adjuvant with Delaro Complete when corn is between the V8 and VT growth stages. Do not make more than 2 sequential applications of Delaro Complete													
Dithane F-45 Rain-shield	-	-	-	x	x	-	x	x	-	mancozeb	dithiocarbamate (M3)	1.2 qt	40 days
Dithane M-45	-	-	-	x	x	-	x	x	-	mancozeb	dithiocarbamate (M3)	1.5 lb	(both formulations)
<b>Remarks:</b> Seasonal use amounts vary according to formulation. Do not feed treated forage to livestock.													
Domark 230 ME	x	x	10	8	x	-	x	6	2ee	tetraconazole	triazole (3)	4–6 fl oz	Do not apply after R3
<b>Remarks:</b> Do not apply more than one (1) application per year.													
Equus DF	-	-	-	x	x	-	x	x	-	chlorothalonil	chloronitriles (M5)	0.7–1.8 lb	14 days
<b>Remarks:</b> Use only on corn grown for seed or sweet corn NOT to be processed. Consult the label for disease-specific recommendations and rates.													
Evito 480 SC	x	x	x	x	x	-	x	x	-	fluoxastrobin	Qol (11)	2.0–5.7 fl oz	30 days
<b>Remarks:</b> Do not apply more than 11.4 fl oz/a (0.36 lb ai/a) per year. No more than two applications/year. Do not apply after R4.													
Evito T	x	x	x	x	x	-	x	x	-	fluoxastrobin + tebuconazole	Qol (11) + triazole (3)	4–9 fl oz	36 days for grain or fodder
<b>Remarks:</b> Do not apply more than 18 fl oz/a/year. No more than two applications per year. For sweet corn, up to 36 fl oz per year can be applied, but no more than two sequential applications should be used before switching to another mode of action.													
Fitness	-	10	x	6	x	-	8	6	-	propiconazole	triazole (3)	2–4 fl oz	30 days
<b>Remarks:</b> Do not apply more than 16.0 fl oz/a/season, more than 8 fl oz/a for corn grown for forage, or more than 0.45 lb ai/a propiconazole-containing product/season.													
Fortix Preemptor	x	x	10	8	x	-	x	8	2ee	fluoxastrobin + flutriafol	Qol (11) + triazole (3)	4.0–6.0 fl oz	R4 Growth stage or 80 days
<b>Remarks:</b> Do not apply more than 12 fl oz/a per crop per season. Do not make more than two applications per season. Do not use adjuvants after the V8 growth stage or before the VT growth stage.													

Efficacy ratings: Excellent = 10; very good = 8; good = 6; fair = 4; poor = 2; no control = 0; labeled, no data = x; not labeled = -; 2ee = Special FIFRA 2(ee) label, check current label status <sup>a</sup> Fungicide group numbers indicate the modes of action; multiple applications of fungicides with the same group number increases the chances for disease resistance.

Continued on next page

Principles of pest management

Corn disease

Soybean

Forages & pastures

Small grains

Stored grain insects

Appendix

**Table 2-10.** Fungicide efficacy for leaf diseases of field corn (hybrid seed production and grain) (continued)

Fungicide	Anthraxnose	Eyespot	Gray leaf spot	Northern corn leaf blight	Northern corn leaf spot	Physoderma brown spot	Rust	Southern rust	Tar Spot	Active ingredient(s)	Chemical family (FRAC code <sup>a</sup> )	Amount/use/a	Preharvest interval (PHI)
Headline EC Headline SC	8	10	10	8	x	x	10	10	-	pyraclostrobin	Qol (11)	6–12 fl oz	7 days
<b>Remarks:</b> Consult the label for disease-specific recommendations and rates. Do not apply more than two applications per season or more than two sequential applications before alternating to a labeled non-Group 11 fungicide. To limit the potential for resistance, do not apply more than 1.18 lb ai pyraclostrobin/a/season. Headline EC is labeled to control Rhizoctonia in corn at the rate of 0.60 fl oz per 1,000 row feet (30-inch rows).													
Headline AMP	x	10	10	8	x	x	10	8	8	pyraclostrobin +metconazole	Qol (11) + triazole (3)	10–14.4 fl oz	20 days for grain and stover; 7 days for forage and silage
<b>Remarks:</b> Consult the label for disease-specific recommendations and rates. Do not make more than four applications per season. Do not apply more than 57.6 fl oz/a/season. Do not make more than two sequential applications before alternating to another fungicide with a different mode of action.													
Manzate Pro-stick Manzate Flowable Manzate Max	-	-	x	x	x	-	x	-	-	manganese ethylene- bisdithio-carbamate	dithiocarbamate (M3)	1.5 lb 1.2 qt 0.8–1.2 qt	40 days for all formulations
<b>Remarks:</b> Do not feed treated forage to livestock. Seasonal use amounts vary according to formulation.													
Miravis Neo	x	x	10	9	x	x	x	8	6	pydiflumetofen +azoxystrobin +propiconazole	carboximides (7) + Qol (11) + triazole (3)	13.7 fl oz	30 days for grain, forage, and stover
<b>Remarks:</b> Do not include a surfactant if applying fungicide between the V8 and VT growth stages.													
Onset 3.6L Orius 3.6F	-	-	x	8	x	-	x	x	-	tebuconazole	triazole (3)	4–6 fl oz	21 days for forage; 36 days for grain and fodder
<b>Remarks:</b> A maximum of 24 fl oz/a may be applied per season.													
Oxidate 2.0	x	-	-	-	-	-	x	-	-	hydrogen dioxide +peroxyacetic acid	unknown (u)	1:400 – 1:40 dilution	0 days
<b>Remarks:</b> Do not apply high rate to blooming crops. Test for phytotoxicity at the high rate. Frequent and repeated applications may be needed when conditions are conducive for disease.													
Penncozeb 75 DF Penncozeb 80 WP Penncozeb 4 FL	-	-	x	x	x	-	x	-	-	manganese ethylene- bisdithio- carbamate	dithiocarbamate (M3)	1.0–1.5 lb 1.0–1.5 lb 0.8–1.2 qt	40 days for all formulations
<b>Remarks:</b> Do not apply more than 12 lb ai/a/season.													
Priaxor	x	x	8	9	x	x	8	8	2ee	fluxapyroxad +pyraclostrobin	carboximides (7) + Qol (11)	4–8 fl oz	21 days
<b>Remarks:</b> Consult label for disease-specific information. Do not apply more than 16 fl oz/a/season. Do not make more than two consecutive applications of Priaxor before alternating to a labeled fungicide with a different mode of action. No more than two applications/season.													

Efficacy ratings: Excellent = 10; very good = 8; good = 6; fair = 4; poor = 2; no control = 0; labeled, no data = x; not labeled = -; 2ee = Special FIFRA 2(ee) label, check current label status <sup>a</sup> Fungicide group numbers indicate the modes of action; multiple applications of fungicides with the same group number increases the chances for disease resistance.

Continued on next page

**Table 2-10.** Fungicide efficacy for leaf diseases of field corn (hybrid seed production and grain) (continued)

Fungicide	Anthracnose	Eyespot	Gray leaf spot	Northern corn leaf blight	Northern corn leaf spot	Physoderma brown spot	Rust	Southern rust	Tar Spot	Active ingredient(s)	Chemical family (FRAC code <sup>a</sup> )	Amount/use/a	Preharvest interval (PHI)
Proline 480 SC	x	10	x	8	x	-	8	6	-	prothioconazole	triazole (3)	5.7 fl oz	14 days for field corn and field corn seed production; 0 days for forage
<b>Remarks:</b> Do not apply more than 22.8 fl oz/a per crop.													
Propicure 3.6F	-	10	6	6	x	-	8	-	-	propiconazole	triazole (3)	2–8 fl oz	30 days
<b>Remarks:</b> Do not apply more than 16 fl oz/a or 8 fl oz/a for corn harvested for forage/season.													
PropiMax EC	-	10	6	6	x	-	8	6	-	propiconazole	triazole (3)	2–4 fl oz	30 days for forage, grain, and stover
<b>Remarks:</b> Consult the label for disease-specific recommendations and rates. Do not apply more than 16 fl oz/a/season. Do not apply more than 8 fl oz/a/season on field corn harvested for forage.													
Prosaro	x	x	x	x	x	-	x	x	-	prothioconazole +tebuconazole	triazole (3) +triazole (3)	6.5 fl oz	21 days for forage, 36 days for grain
<b>Remarks:</b> Do not apply more than 26 fl oz of Prosaor per acre per year. Do not use adjuvants with prosaro if corn is between the V8 and VT growth stages.													
Quadris	6	6	10	6	x	x	10	6	-	azoxystrobin	QoI (11)	6.0–15.5 fl oz	7 days
<b>Remarks:</b> Consult the label for disease-specific recommendations and rates. Do not apply more than 123 fl oz of product/a/season. Do not apply more than 2.0 lb ai/a/season of azoxystrobin-containing products. Do not use adjuvants or other additives after V8 growth stage and prior to the VT growth stage as stress or injury may occur.													
Quilt	x	10	10	8	x	-	9	8	-	azoxystrobin +propiconazole	QoI (11) + triazole (3)	7–14 fl oz	30 days for forage, grain, or stover
<b>Remarks:</b> Consult the label for disease-specific recommendations and rates. Apply no more than two applications of Quilt or any other group-11 fungicides per year or 56 fl oz/a/season. Do not apply more than 28 fl oz for field corn harvested for forage. Do not apply more than 0.45 lb ai of propiconazole-containing products/a/season or more than 2.0 lb ai azoxystrobin-containing products/a/season.													
Quilt Xcel	8	9	10	8	x	-	9	8	-	azoxystrobin +propiconazole	QoI (11) + triazole (3)	10.5–14 fl oz	30 days for forage, grain, or stover
<b>Remarks:</b> Consult the label for disease-specific recommendations and rates. Do not apply more than 56 fl oz/a/season. Do not apply more than 28 fl oz for field corn harvest for forage. Do not apply more than 0.45 lb ai propiconazole-containing products/a/season or more than 2.0 lb ai azoxystrobin-containing products/a/season.													
Revytek	x	x	9	9	x	x	x	8	8	mefentrifluconazole + pyraclostrobin + fluxapyroxad	triazole (3) +QoI (11) +carboximides (7)	8.0–15.0 fl oz	21 days
<b>Remarks:</b> Do not apply more than 30 fl oz per acre per year. Do not add an adjuvant if apply between the V8 and VT growth stages.													

Efficacy ratings: Excellent = 10; very good = 8; good = 6; fair = 4; poor = 2; no control = 0; labeled, no data = x; not labeled = -; 2ee = Special FIFRA 2(ee) label, check current label status <sup>a</sup>Fungicide group numbers indicate the modes of action; multiple applications of fungicides with the same group number increases the chances for disease resistance.

Continued on next page

Principles of pest management

Corn disease

Soybean

Forages &amp; pastures

Small grains

Stored grain insects

Appendix

**Table 2-10.** Fungicide efficacy for leaf diseases of field corn (hybrid seed production and grain) (continued)

Fungicide	Anthraxnose	Eyespot	Gray leaf spot	Northern corn leaf blight	Northern corn leaf spot	Physoderma brown spot	Rust	Southern rust	Tar Spot	Active ingredient(s)	Chemical family (FRAC code <sup>a</sup> )	Amount/use/a	Preharvest interval (PHI)
Stratego YLD	8	8	10	8	x	x	10	6	-	prothioconazole + trifloxystrobin	triazole (3) + Qol (11)	2.0–5.0 fl oz	14 days for grain and fodder; forage may be harvested the same day of application
<b>Remarks:</b> Do not apply more than 10 fl oz/a/season. Do not apply more than two sequential applications or any other Group-11 fungicide without alternating with a fungicide from another group.													
Tilt	-	10	6	6	x	-	8	4	-	propiconazole	triazole (3)	2.0–4.0 fl oz	30 days for forage, grain, or stover
<b>Remarks:</b> Consult the label for disease-specific recommendations and rates. Do not apply more than 16 fl oz /a/season Do not apply more than 8 fl oz/a/season on field corn harvested for forage. Do not apply more than 0.45 lb ai propiconazole-containing products/a/season.													
Toledo	-	-	10	8	x	-	x	-	-	tebuconazole	triazole (3)	4–6 fl oz	21 days for forage; 36 days for grain
Topaz	-	10	6	6	x	-	8	6	-	propiconazole	triazole (3)	2–4 fl oz	30 days
<b>Remarks:</b> Do not apply more than 16 fl oz/a or more than 8 fl oz/a on field corn harvested for forage/season. Do not apply more than 0.45 lb ai/a propiconazole-containing products/season.													
Topguard	x	x	x	x	-	-	x	x	-	flutriafol	triazole (3)	3.4–6.8 fl oz	80 days
<b>Remarks:</b> No single application of product can exceed 14 fl oz/a. Do not exceed two applications per season.													
Topguard EQ	-	x	8	7	x	-	4	7	2ee	azoxystrobin + flutriafol	Qol (11) + triazole (3)	5.0 – 7.0 fl oz	7 days
<b>Remarks:</b> Do not apply more than 14 fl oz per acre per year. Do not exceed 7 fl oz per acre for any single application. Do not use an adjuvant wwith Topguard EQ between the V8 and VT growth stages.													
Trivapro	8	9	10	8	x	x	9	10	7	benzovindiflupyr + azoxystrobin + propiconazole	carboximides (7) + Qol (11) + triazole (3)	13.7 fl oz	30 days
<b>Remarks:</b> Do not apply more than two applications before switching to a non-group 7 or 11 mode of action. Do not apply more than 47 fl oz per acre per year.													
Veltyma	x	x	9	9	x	x	x	8	9	mefentrifluconazole + pyraclostrobin	triazole (3) + Qol (11)	7.0-10.0 fl oz	21 days
<b>Remarks:</b> Do not apply more than 20 fl oz per acre per season for all corn types except sweet corn, where 30 fl oz per year can be applied. Do not add an adjuvant if applying between the V8 and VT growth stages.													
Vertisan	x	x	x	x	x	x	x	x	-	penthiopyrad	carboximides (7)	10–24 fl oz	7 days
<b>Remarks:</b> Make no more than two sequential applications before switching to a fungicide with a different mode of action.													

Efficacy ratings: Excellent = 10; very good = 8; good = 6; fair = 4; poor = 2; no control = 0; labeled, no data = x; not labeled = -; 2ee = Special FIFRA 2(ee) label, check current label status <sup>a</sup>Fungicide group numbers indicate the modes of action; multiple applications of fungicides with the same group number increases the chances for disease resistance.

Continued on next page

**Table 2-10.** Fungicide efficacy for leaf diseases of field corn (hybrid seed production and grain) (continued)

Fungicide	Anthrachnose	Eyespot	Gray leaf spot	Northern corn leaf blight	Northern corn leaf spot	Physoderma brown spot	Rust	Southern rust	Tar Spot	Active ingredient(s)	Chemical family (FRAC code <sup>a</sup> )	Amount/use/a	Preharvest interval (PHI)
Viathon	-	-	x	x	x	-	4	x	-	potassium phosphite + tebuconazole	phosphonate (33) + triazole (3)	2-3 pt	7 days
<b>Remarks:</b> Do not apply more than 12 pints/acre per season.													
Xyway	-	-	6	8	-	2ee	x	-	-	flutriafol	triazole (3)	7.6 – 15.2 fl oz	N/A
<b>Remarks:</b> This is an in-furrow or soil-applied at-plant product. Follow label and local recommendations carefully. Do not apply more than 0.488 lb of flutriafol per acre per season including at-plant plus foliar applications of other products.													

Efficacy ratings: Excellent = 10; very good = 8; good = 6; fair = 4; poor = 2; no control = 0; labeled, no data = x; not labeled = -; 2ee = Special FIFRA 2(ee) label, check current label status <sup>a</sup> Fungicide group numbers indicate the modes of action; multiple applications of fungicides with the same group number increases the chances for disease resistance.

covered by plowing or where corn does not follow corn in the rotation.

**Northern corn leaf blight (NCLB)** occurs statewide, but historically it has been more severe in low-lying fields.

Many hybrids have some tolerance to NCLB. In addition to a multiple gene resistance, which imparts fair-to-good resistance in some hybrids, the single dominant “Ht1” gene has been introduced into many hybrids to provide an apparent high degree of resistance. The addition of this gene within one parent of a hybrid cross can change a susceptible hybrid to a resistant form but leaves the general agronomic characteristics of the hybrid unaffected. If your seed dealer indicates that a formerly NCLB-susceptible hybrid is now resistant, this may be the reason. Some hybrids may contain both forms of genetic resistance. NCLB resistance is desirable throughout the state.

A strain of the NCLB fungus is common in the Midwest and will infect hybrids or inbreds with the “Ht1” gene. Wisconsin corn growers should be watchful for the occurrence of NCLB in hybrids rated as resistant. An “HtN” gene is being incorporated in

some hybrids to control this new race. If certain fields have had high levels of NCLB despite the use of a resistant hybrid, you might inquire with your seed dealer about using a hybrid with the “HtN” form of resistance.

**Northern leaf spot (NLS)** can be a problem for some corn hybrids. A certain strain of the fungus *Bipolaris zeicola*, which causes NLS, can induce considerable damage to certain corn inbreds produced in the upper Midwest. Inbreds with B73 background, a popular inbred for the region, appear to be most susceptible. Hybrids from affected crosses show limited foliage symptoms with no apparent effect in yields. Thus, this pathovar is primarily a problem for the seed corn industry. Two sets of symptoms have occurred in Wisconsin, one affecting foliage, and the other affecting the roots and crowns of young plants. Lesions (leaf spots) develop first on the lower leaves. Given warm, wet conditions, the lesions move rapidly upward. Symptoms are variable depending in part upon the cultivar affected. Most often the lesions are elliptical (football shaped), 0.125 to 0.5 inches long, and have dark margins and light tan

centers. There may be some yellowing (chlorosis) surrounding the spots. On other inbreds, the spots have appeared quite narrow and linear, at least initially.

The seedling blight phase of NLS has been prevalent in susceptible inbreds in some fields. Similar to cutworm injury symptoms, plants just emerging to 15 inches tall collapsed after showing sudden wilting. Root and crown examination revealed extensive dark brown internal and external discoloration beginning in the crown area of the plant.

Crop rotation is not a highly effective control measure, and chemical controls have proven inconsistent to date. If trying fungicides, watch for symptoms on foliage especially after tasseling. Begin treatment if lesions are present and if weather is warm and wet. Continue applications every 7 days during favorable weather up until 10 days before harvest. Seed treatments do not protect seedlings from the root and crown phase of the disease.

**Eyespot** can be severe when unusually cool, wet weather prevails, when

corn is infrequently rotated, and when corn is grown under no-till or minimum tillage. Early-maturing hybrids appear to be more susceptible than full-season hybrids. If severity on leaves is higher than 50%, eyespot can directly reduce grain yields; severe eyespot may predispose plants to stalk rot and ear rot because of early death and dryness. Generally in field corn, eyespot is more of a cosmetic issue. In sweet corn, eyespot may be more of a yield-limiter.

**Common rust** occurs each year but generally does not cause yield losses. The rust fungus does not overwinter in Wisconsin but is carried by winds from the southern states. This factor, along with its sensitivity to weather conditions, makes it a difficult disease to predict. The fungus produces oval or elongated cinnamon-brown blisters (pustules) scattered on both surfaces of the leaves. As the corn matures, the pustules become black. Rust can prematurely kill corn leaves if the disease develops early in the season and wet weather prevails. Most corn hybrids are considered resistant or tolerant.

**Southern rust** does not occur every year in Wisconsin. This rust fungus also has to be blown in from the southern states. Because of this phenomenon, it generally does not cause significant yield losses, because it arrives too late to affect yield. However, in years when weather is conducive and the fungus infects corn prior to the dough growth stage, management using fungicides will be needed to preserve yield. Very little genetic resistance is available in current corn hybrids. This fungus produces circular bright orange pustules, which generally occur only on the upper surface of the leaf. A yellow halo can be observed surrounding the lesion, on the underside of the leaf.

**Gray leaf spot (GLS)** is common in southern Wisconsin. GLS is more severe if corn is planted continuously and if corn residue is left on the soil surface. Corn hybrids differ in reaction to GLS.

**Corn smut** can be recognized by the gray galls that form on all plant parts. When the galls mature, they break open, exposing the black powdery spores of the fungus. Galls that form on the ears and on the stalk above the ear can reduce yield. Most hybrids have good resistance to smut, but this resistance can be altered by hot, dry weather, mechanical injury, hail, and herbicide injury. Excessive application of nitrogen or manure may result in more smut than normal. Smutty corn is not harmful if fed to livestock. Foliar fungicides will usually not be needed to control corn smut.

**Stewart's bacterial wilt** has been documented in seed cornfields in Wisconsin. Stewart's wilt is caused by a bacterium that is transmitted by the corn flea beetle. The severity of Stewart's bacterial wilt is directly related to beetle population levels.

There are two phases of the disease. One phase affects young plants that are infected by corn flea beetles that survive the winter. Usually infected seedlings rapidly wilt and die. The second and more common phase is a leaf blight that is most apparent after tasseling. Lesions on leaves are gray to green to yellow green and develop as streaks along the veins. Symptoms of Stewart's bacterial wilt may be confused with symptoms associated with northern corn leaf blight caused by a fungus. The use of resistant corn hybrids is the most economical control.

**Goss's wilt** has recently reemerged in Wisconsin and other areas of the Corn Belt. This bacterial disease has symptoms that can confuse it with other diseases like Stewart's wilt, Northern corn leaf blight, and Diplodia leaf streak, so proper identification is important. Symptoms include distinct light tan or yellow to gray lesions with wavy or irregular margins following the leaf veins. Dark green to black specks or flecks (freckles) are found within the lesions, which often have a shiny appearance due to the bacteria oozing onto the leaf surface. Lesions can coalesce, leading to whole leaves being blighted. In severely infected

plants, wilting and stalk degradation can also occur, causing plant death. Examine stalks for Goss's wilt by splitting the tissue and looking for an orange to brown color with water-soaked and slimy tissue.

Management of this disease is focused on selecting hybrids with good resistance, residue management, and crop rotation. This includes tilling fields immediately after harvest to bury residue and planting a nonhost crop like soybean in the subsequent growing season.

**Tar spot** is a relatively new disease in the United States and Wisconsin. It was first identified in Wisconsin in 2016. A major epidemic of this disease occurred in 2018 across the entire upper Midwest. This epidemic resulted in significant yield reductions in Wisconsin. Signs and symptoms include raised black bumps (tar-like spots) that do not rub or scrap off and occur on any green part of the corn plant. In severe cases necrotic spots form around the black tar spots and can coalesce, resulting in leaf death. If conditions are conducive the disease can increase quickly, and premature death of corn plants can occur.

Management of tar spot includes choosing hybrids with partial resistance. No complete resistance is known, but some hybrids have shown better resistance than others. Residue management and rotation can also reduce severity. However, it should be noted that tar spot has occurred in fields rotated from soybean to corn with no history of the disease. Some fungicides are labeled for control of tar spot and have demonstrated suppression relative non-sprayed checks. Timing of application may influence the ability of the fungicide to control tar spot.

## Stalk rot

Stalk rot causes substantial losses each year through early plant kill or preharvest stalk lodging. It causes premature death of some plants, fermenting or rotting stalks, and a discolored pith that weakens the

**Table 2-11.** Nematode genera associated with corn in Wisconsin

Genus (common name)	Incidence in Wisconsin	Potential damage	Symptoms	Other hosts
<i>Pratylenchus</i> (root lesion)	very common	moderately damaging	smaller-than-normal root system, darkened and discolored roots, moderate stunting	grasses, cereals, legumes, and vegetables <i>Host range is different for each species of root-lesion nematode.</i>
<i>Longidorus</i> (needle)	common	very damaging in sandy soils	severe stunting, chlorosis, severe root pruning, root system consists mainly of short, stubby, thickened side roots that appear somewhat swollen	grasses and potatoes
<i>Hoplolaimus</i> (lance)	occasional	moderately damaging	reduced root system., darkened and discolored roots, moderate stunting.	grasses and legumes
<i>Xiphinema</i> (dagger)	occasional	moderately damaging	severe plant stunting, chlorosis, few fine feeder roots	grasses and legumes
<i>Helicotylenchus</i> (spiral)	occasional	damaging only at high populations	smaller-than-normal root system, root decay, mild stunting	grasses and legumes
<i>Tylenchorhynchus</i> (stunt)	occasional	damaging only at high populations	smaller-than-normal root system, moderate stunting, chlorosis	grasses, cereals, and legumes
<i>Trichodorus</i> (stubby root)	rare	very damaging	stubby lateral roots, coarse roots, excessive upper roots, severe stunting, chlorosis	grasses, legumes, potatoes, cabbages, and beets

stalk. Stalk rot is caused by a complex of fungal organisms that are particularly damaging to plants subjected to stress during the growing season. High soil moisture in August appears to favor root infection of *Pythium* spp. This fungal infection leads to early plant death and subsequent stalk rot. Small ears and lodging often are the result of the early plant kill phase of the stalk rot disease.

Complete control of stalk rot is difficult, but you can take several steps to reduce the problem:

1. Select hybrids that perform best under your system of farming.
2. Maintain a high level of potassium in accordance with soil test recommendations.
3. Control blight diseases, which cause early leaf kill and increase the susceptibility to stalk rot.
4. Grow full-season corn hybrids where possible; early-maturing hybrids generally suffer more from stalk rot.

5. Harvest as early as practical to prevent greater losses from stalk lodging.
6. Minimize plant stresses during the growing season by controlling leaf-feeding insects and borers and irrigating during droughty conditions. Also, avoid unprofitably high plant populations and excessive applications of nitrogen, as both of these stresses increase stalk rot severity.

The nitrogen stabilizer nitrapyrin (NServe) reduces soil nitrogen losses from leaching, and it also reduces the incidence and severity of stalk rots in some tests. Less stalk lodging may be another benefit of NServe.

**Anthracnose** symptoms generally appear on the stalk after tasseling as narrow, vertical or oval, water-soaked lesions in the rind. These lesions become tan to reddish brown and eventually dark brown to black late in the season. Black lesions and patches may cover the lower internodes or the entire stalk. Black specks (spore-bearing structures) occasionally are found

on the stalk rind. The black external lesions form large, shiny black areas or streaks that may be sunken. Internally, the pith tissues will be decayed and brown to black.

Occasionally, leaves above the ear may die 4-6 weeks after pollination while the lower portions of the plant remain green. The upper leaves may turn yellow or red, lodge, and drop off. In some cases, plants may die prematurely and later lodge. Lodging normally is found higher on the stalk when compared to other stalk rot diseases. Anthracnose also can cause a leaf spot phase that usually is not important on field corn but sometimes damages sweet corn.

Control recommendations are resistant hybrids (especially in minimum tillage fields), crop rotation or deep incorporation of corn debris, and balanced fertility.

### Root and crown rot

Severe root and crown infections can cause sudden, premature death of plants early in the season or in late

Principles of pest management

Corn disease

Soybean

Forages & pastures

Small grains

Stored grain insects

Appendix

August and early September. Affected plants typically develop a uniformly gray to light green appearance a few days before they turn white. Kernels soon shrivel and are somewhat loose on the ears. Stalks are usually firm at this stage, although stalk rot frequently follows.

Symptoms often occur in pockets, although plants can be individually damaged. The primary effect on the crop is a loss from premature plant kill and increased harvesting problems.

Roots usually collapse and appear discolored from their tips toward the base of the stalk. Symptoms progress internally from the crown tissue upward into the stalk. Brace roots are also affected. The base of brace roots appear shriveled, though not necessarily discolored. *Pythium*, a “water mold” fungus, is believed to be the primary pathogen causing root rot in Wisconsin. Damage may be more severe in low, poorly drained sites and in many sites during years when abundant rains occur in July and August.

No control measures are available, although varieties appear to differ in susceptibility. No relationship to stalk-rot tolerance is believed to exist. The influence of rotations and fertility is not known. Early harvest of severely affected fields should minimize losses.

### Nematode diseases

Fields with nematode problems occur in most regions of the state on sandy to clay loam soils. The lesion, lance, and needle nematodes appear to be the most prevalent nematode species associated with corn (Table 2-11). In Wisconsin, high populations of nematodes reduce corn yields (Table 2-12).

Disease caused by nematodes can be confused with other plant stresses such as low moisture, nutrient deficiencies, and soil compaction. Nematode damage may actually intensify the effects of low soil moisture and low soil fertility. Typical symptoms are small stalks, small ears, and nutrient deficiency symptoms. Nematode problems are diagnosed by examining the soil and

**Table 2-12.** Corn nematode populations associated with yield loss

Genus (common name)	Nematodes/ 100 cc of soil	Nematodes/g of dry root
<i>Pratylenchus</i> (lesion)	100	500
<i>Longidorus</i> (needle)	1	—
<i>Hoplolaimus</i> (lance)	100	300
<i>Xiphinema</i> (dagger)	50	—
<i>Helicotylenchus</i> (spiral)	200	—
<i>Tylenchorhynchus</i> (stunt)	200	—
<i>Trichodorus</i> (stubby root)	50	—

roots for these microscopic soil organisms. Do not rely on visual assessments of corn plants to determine if damage is due to nematodes.

**Sampling for corn nematodes.** A nematode assay can be used to confirm a suspected nematode problem or to eliminate nematodes as one of several possible causes of poor plant growth.

The best results are obtained when soil and root samples are taken 4-8 weeks after planting. Nematode populations at this time appear to correlate best with yields obtained in the fall. However, late summer or fall samples also can be useful in predicting next year’s problems. Spring samples are less valuable.

Nematode damage to corn often appears in circular or oval pockets in the field. Rarely does an entire field show severe symptoms. Sample the suspected area.

Most laboratories require a fee to process samples for nematode analysis. You may want to contact the laboratory before submission. This is important because some laboratories may require plant or root ball samples in addition to soil samples. Table 2-13 lists laboratories that test for nematodes.

There are several ways to take a soil sample for nematode analysis. The following is a general guide:

1. Use a soil probe (preferred) or narrow-bladed trowel or shovel. Take samples close to plants at a depth of 8-10 inches. Discard the upper 2

inches of soil, especially if it is dry. Be sure to include plant roots.

2. One sample is adequate for a 10-acre field or for a suspected area within the field. Sample soil and roots from 20-25 plants and mix into one sample; 1-2 pints of soil is adequate. Sample from plants in the margins of suspected areas and not from their centers. If there is no visible damage, use a zig-zag, W-, or X-shaped pattern to sample the field.
3. Place samples in sturdy plastic bags (do not use paper bags), fasten the open end securely, and accurately label the samples. Use care with the samples as nematodes need to be alive. Do not place samples where they can become dry and overheated. Mail samples early in the week to avoid delays in transit.

Laboratories will report the number of nematodes in nematode per pint (500 cc) of soil, per 100 cc of soil, or per gram of dry root. Each lab may have its own damage thresholds for individual nematode species. However, each lab will give an assessment regarding the possibility of economic damage.

Corn growers can use soil-test reports and strip tests (effective nematicides compared to no treatment) to determine if nematodes are reducing corn yields on their farms. If rootworms are present in a field, the strip test should include an effective insecticide/nematicide rather than a product

that gives rootworm control but no nematode control.

If economic populations of nematodes are detected, you can use these control recommendations:

- **For chemical control, Counter 20G, Mocap 15G, Avicta Complete Corn, and Poncho/VOTiVO are registered nematicides for corn.** Thimet 20G, Lorsban 15G, and all other soil insecticides are not registered as nematicides. Counter 20G and Mocap 15G are more effective if applied in a 7-inch band at planting rather than in the furrow. Counter 20G is also registered as a corn soil insecticide, such as for corn rootworm control. However, the rates differ for nematode control. See corn rootworm discussion in the **Corn insect management** section for additional information on this chemical. Follow the label directions closely. Avicta Complete Corn and Poncho/VOTiVO are commercially applied seed treatments that are labeled to provide early season protection from plant pathogenic nematodes that attack the root system.
- **Maintain high soil fertility.** Nutrient-deficient plants are more susceptible to nematode injury.

- **Practice good weed control.** Many weeds are good hosts and will help maintain or even increase nematode populations.
- **Crop rotation may be valuable,** but little is known about the susceptibility of other crops to nematodes commonly found on corn.

### Ear rot

Corn is susceptible to several ear rot fungi that reduce the yield, quality, and feeding value of the grain. Many of these fungi are capable of producing poisonous metabolites called mycotoxins that affect animal health. *Gibberella* and *Fusarium* ear rot are the most common ear rot diseases in Wisconsin. The prevalence and severity of ear rot is associated with above-normal rainfall from July through October, insect feeding on ears, severity of leaf diseases, and hail injury to ears.

Many fungi that cause ear rots also produce mycotoxins that are harmful if fed to livestock. The fungus that causes *Gibberella* ear rot produces mycotoxins that cause reproductive problems in swine. It also produces a mycotoxin called a refusal factor. If the refusal factor is present, swine will not eat the grain.

The following suggestions may help control corn ear rots.

1. Choose a corn hybrid less susceptible to rot. Ears that are well covered by husks and those that mature in a reclining position have less rot than ears with open husks or those that mature upright. Hybrids that are susceptible to leaf diseases may have more ear rot. Full-season hybrids have fewer ear rot problems than early-maturing hybrids.
2. Control corn earworms and corn borers where practical.
3. Harvest early.

Consider the following strategies when ear rots are prevalent.

- Harvest early; the risk of mycotoxin production increases as the harvest season progresses.
- Harvest as shelled corn or silage. The fungi associated with ear rots will cease activity in corn with less than 20% moisture content and will not survive the activities of fermentation in the silo. Problems may continue if stored as cribbed ear corn.

**Table 2-13.** Directory of nematology laboratories

#### State laboratories

Wisconsin  
Plant Disease Diagnostic Clinic  
Department of Plant Pathology  
UW-Madison  
1630 Linden Drive  
Madison, WI 53706-1598  
(608) 262-2863  
<https://pddc.wisc.edu>

Illinois  
University of Illinois Plant Clinic  
1102 S. Goodman  
S-417 Turner Hall  
Urbana, IL 61801  
(271) 333-0519  
[web.extension.illinois.edu/plantclinic](http://web.extension.illinois.edu/plantclinic)

Iowa  
ISU Plant and Insect Diagnostic Clinic  
327 Bessey Hall  
Iowa State University  
Ames, IA 50010  
(515) 294-0581  
[www.ent.iastate.edu/pidc](http://www.ent.iastate.edu/pidc)

#### Private laboratories

Midwest Laboratories  
13611 B Street  
Omaha, NE 68144  
(402) 334-7770  
[www.midwestlabs.com](http://www.midwestlabs.com)

Allied Cooperative/Pest Pros Consultants  
540 S. Main St.  
Adams, WI 53910  
800-247-5679  
<http://www.allied.coop/index.cfm>

Principles of pest management

Corn disease

Soybean

Forages & pastures

Small grains

Stored grain insects

Appendix

**Table 2-14.** Directory of mycotoxin laboratories

The following laboratories can offer qualitative and quantitative analysis for mycotoxins that include but are not limited to aflatoxins, DAS, fumonisin, ochratoxins, T-2, vomitoxin, and zearalenone. Contact individual laboratories directly for information about prices and services, sample submission, and other details.

Cumberland Valley Analytical Services, Inc. P.O. Box 669 Maugansville, MD 21767 <a href="http://www.foragelab.com">www.foragelab.com</a> (800) 282-7522	Rock River Laboratory, Inc. 710 Commerce Drive P.O. Box 169 Watertown, WI 53094-0169 <a href="http://www.rockriverlab.com">www.rockriverlab.com</a> (920) 261-0446	Veterinary Diagnostic Labs Iowa State University 1600 South 16th Street Ames, IA 50011 <a href="http://vetmed.iastate.edu/diagnostic-lab">vetmed.iastate.edu/diagnostic-lab</a> (515) 294-1950
Dairy One Forage Lab Services 730 Warren Road Ithaca, NY 14850 <a href="http://dairystone.com">http://dairystone.com</a> (607) 257-1272	Romer Labs, Inc. Attn: Analytical Services 1301 Stylemaster Lane Union, MO 63084-1156 <a href="http://www.romerlabs.com">www.romerlabs.com</a> (636) 583-8600	Veterinary Medical Diagnostic Laboratory University of Missouri 1600 East Rollins Columbia, MO 65211 <a href="http://vmdl.missouri.edu">vmdl.missouri.edu</a> (573) 882-6811
Dairyland Laboratories 217 East Main Street Arcadia, WI 54612 <a href="http://www.dairylandlabs.net">www.dairylandlabs.net</a> (608) 323-2123	North Dakota Veterinary Diagnostic Laboratory North Dakota State University 174 Van ES Hall 1523 Centennial Boulevard Fargo, ND 58102 <a href="http://www.vdl.ndsu.edu">www.vdl.ndsu.edu</a> (701) 231-8307	
Midwest Laboratories 13611 B Street Omaha, NE 68144 <a href="http://www.midwestlabs.com">www.midwestlabs.com</a> (402) 334-7770		

**Table 2-15.** Some mycotoxins and their effects

Toxin or syndrome and (primary) fungal source	Possible animal effects
<b>Aspergillus</b> toxins (primarily)	
Aflatoxins (B1, B2, G1, and G2; B1 is most important)	Liver damage; carcinogenic; reduced growth; hemorrhaging
Ochratoxins	Kidney and liver damage; abortion
Sterigmatocystin	Generally toxic; carcinogenic
Tremorgenic toxin	Tremors and convulsions
<b>Penicillium</b> toxins (primarily)	
Patulin	Lung and brain hemorrhages; edema; kidney damage; possibly carcinogenic
Rubratoxin	Liver damage; hemorrhaging
Citrinin	Kidney damage
<b>Fusarium</b> toxins	
Emetic factor, vomitoxin (deoxynivalenol, DON)	Vomiting; feed refusal by swine, cats, and dogs
Feed refusal factor (may be same as above)	Feed refusal by swine
Other trichothecenes such as T-2, MAS, DAS	Inflammation of gastrointestinal tract; possible hemorrhaging, edema, vomiting, infertility, and other symptoms
Zearalenone and zearalenol (estrogenic syndrome)	Increased estrogenic activity; infertility

**Table 2-16.** Max. time for storage of shelled corn at various corn moisture and air temperatures<sup>a</sup>

Storage air temperature	Corn moisture content			
	15%	20%	25%	30%
	days			
75° F	116	12.1	4.3	2.6
70° F	155	16.1	5.8	3.5
65° F	207	21.5	7.8	4.6
60° F	259	27.0	9.6	5.8
55° F	337	35.0	12.5	7.5
50° F	466	48.0	17.0	10.0
45° F	725	75.0	27.0	16.0
40° F	906	94.0	34.0	20.0
35° F	1,140	118.0	42.0	25.0

<sup>a</sup> The times given above are those in which mold growth will cause enough loss in corn quality to bring about a lowering of grade or permit mold growth that could result in mycotoxin formation. Data are from USDA Farmer's Bulletin No. 2238, *Guidelines for Mold Control in High-Moisture Corn*.

### Corn molds and livestock disorders (mycotoxins)

Moldy grain is not only a grading factor in determining the quality and price of the product, but it can also affect livestock health and milk quality. Some molds under the right environment produce mycotoxins. These may accumulate in the field as corn matures or, more often, during transportation and/or storage.

Several common fungi associated with corn produce many different mycotoxins. Some fungi, such as the *Fusarium* (also called *Gibberella*) fungus that causes pink ear rot, may start in the field. Infection commonly occurs during the silking stage and gradually develops, especially as the grain matures during cool, wet fall periods. This fungus produces several known toxins that actually develop most commonly after fungal growth has occurred, when moderately cool temperatures prevail (50-70°F) and kernel moisture is above 20%. These conditions not only exist during many fall seasons, but they can occur when grain sits in bins before grain drying or in feeder boxes. The *Aspergillus flavus* fungus, which was associated with the aflatoxin problem of the drought seasons of 1988 and 2012, can also have its start in the field, but like most other mycotoxin-associated fungi,

it is likely to be more damaging as it develops in storage.

Each fungus has its own environmental niche for growth and development. *Cladosporium*, a black fungus found in cold, wet fields, will grow below freezing. Fortunately, it doesn't produce any known toxin. Most *Aspergillus* and *Penicillium* species are "storage" fungi only; they're not found abundantly in field corn, and most are favored by higher temperatures. However, *Aspergillus glaucus* can grow at 13.5% grain moisture (72% relative humidity), and some *Penicillium* species can grow at 35°F and around 16% moisture. Growth is slow at first, but heat and moisture migration encourages more rapid mold growth.

Fortunately, the presence of a particular fungus does not mean the poison mycotoxin also is present, but it can be cause for concern. The molds are not always easy to see. Moreover, in most instances, once the poison mycotoxin has been produced, it is not readily destroyed, even when the fungus itself is stopped or killed. Consequently, the steps outlined to prevent mold buildup, and possibly subsequent mycotoxin development, are important to follow.

Mold control recommendations include prompt drying after harvesting to 13% moisture or below (especially for longer term storage) or

removing oxygen, which is required for mold growth, by proper ensiling. Feed corn can also be treated for temporary storage with propionic or other labeled organic acids. None of these destroy toxins, but they prevent accumulated buildup. See comments under **Storage Diseases**.

Should you suspect a moldy feed problem, stop using that feed and call a veterinarian. Table 2-14 lists several laboratories that will test feed for some of the toxins listed above.

Table 2-15 shows some recognized mycotoxins associated with certain fungi attacking corn and possible animal effects.

### Storage diseases

You can store grain for several years with little or no loss of quality if you maintain it at proper moisture content. For example, corn at 13% moisture content or lower can be stored indefinitely regardless of temperature. Note that this is below the 15.5% moisture content required for No. 2 grade corn. Corn at 15.5% moisture content can be safely stored for extended periods of time if the grain temperature is low. However, problems can develop as the grain temperature rises in the spring and during the summer. Table 2-16 charts how long grain can be stored at various temperatures before corn will begin to decay, given the grain's moisture content.

Microbial activity may result in loss of nutrients in the grain; microbes produce heat during growth, and heat damage can occur. Certain microorganisms, mainly fungi, produce toxins (mycotoxins) that can cause illness or even death when consumed by livestock or humans. Since microorganisms affect the value of stored grains in many ways, it is extremely important to minimize this activity.

Storage life of shell corn depends on a combination of factors including moisture content, temperature, degree of invasion by storage fungi, and length of time the corn is to be stored.

The following suggestions may help control corn storage diseases.

- Clean bins thoroughly before filling.
- Dry shell corn to 12 or 13% moisture content. No damaging invasion by storage fungi will occur below this level.
- Store shelled corn in weathertight bins. Snow and rain are external sources of moisture that can raise the moisture content of stored grain.
- Check stored grain frequently, especially during warm weather. Collect grain samples from several areas in the bin, including the center. A sampling procedure is outlined in Table 2-17.

In circular bins, the grain surface can be divided into “pie sections” for sampling. Make temperature samples by probing the grain 12-15 feet with a shielded small-diameter thermometer screwed onto a threaded pipe extension. A good routine to follow is to leave the temperature probe in place while making probes for moisture content. A 6-foot compartmentalized grain trier or implement is best for making probes for moisture content determinations. Do not combine samples when making moisture content determinations. It is important to know the highest moisture content of the bin and where it is located, not an overall bin average. The highest moisture area can serve as a source for moisture migration and is the area where storage fungi will first become active.

- Never inspect grain bins alone. Many people have been covered by grain and suffocated. Work in teams of three, one member wearing a safety line while inside the bin, and the other two handling the line outside. Also, place a sign outside the bin that warns others that people are inside the facility.

- Aeration systems for grain bins can maintain grain quality by reducing the temperature of stored corn and keeping the temperature uniform throughout the bin to prevent moisture migration. You can minimize the problem of moisture migration by keeping the temperatures of the grain in the center of the bin within 10°F of the average grain temperature near the bin wall. To do this, use aeration fans that pull the air down through the grain at airflow rates of at least 10 cubic foot per minute (cfm) for each bushel of grain in the bin. Aerate the grain until the temperature of the grain mass is within 10°F of the average monthly temperature. It is not necessary to lower grain temperatures below 40°F because most grain storage fungi are not active below this temperature. Also, aeration systems should not be used to raise the temperature above 60°F because fungi and insects are more active above this temperature.
- Control storage insects; their

**Table 2-17.** General guide for sampling stored grain

Probe depth	Bin diameter	
	< 24 ft	> 24 ft
----- samples/bin -----		
Temperature probes		
shallow	1	1 <sup>a</sup>
deep	3	5
Moisture probes		
shallow	1 <sup>a</sup>	3
deep	5	10

<sup>a</sup> In the bin center

activities can increase the moisture content of grain. Fumigation may rid grain of insects but not storage fungi.

- Store high-moisture grain in airtight silos or treat grain with organic acids.

When “hot spots” or a crust of moldy corn is found, follow these steps:

1. The decayed and moldy corn should be discarded if mold is severe. Corn with some mold can be dried and fed to livestock, but caution should be exercised. Moldy corn can be fed with less risk if mixed with sound corn but is considered unsafe for **all** breeding animals.
2. The remaining corn can be turned and thoroughly mixed to redistribute moisture and allow heat to escape. Aeration does this more cheaply and effectively than transferring grain from bin to bin and does not crush and break kernels.

**Notes:**

# SOYBEAN PEST MANAGEMENT

# Soybean weed management

**H**erbicide treatments are specific as to time and method of application, soil type, rate applied, and are weed species specific. Crops that follow in rotation are also important considerations. Assist your herbicide treatment with a rotary hoe and row cultivation where soybean are planted in wide rows. For narrow-row soybean, use a rotary hoe and an increased planting rate to place soybean seedlings in the most competitive position with weeds. Mechanical weed control is seldom an option in no-till soybean. Check fields regularly to be sure that weeds are being managed on a timely basis.

Many herbicide combinations are registered for use on soybean (see tables 3-1a and 3-1b). The use of herbicide combinations that are not registered is discouraged since liability for performance and crop injury lie solely with the user (and it is illegal). Similarly, the combination of herbicides with fertilizers or insecticides for simultaneous application is discouraged unless the herbicide label outlines directions for such combination use. Be sure to check the herbicide label or accompanying literature carefully before using herbicides in combination with fertilizers, insecticides, or other herbicides.

## Burndown herbicides for no-till soybean

No-till cropping systems are increasingly popular because they offer economic and environmental benefits. Weed management is particularly important in these systems because tillage is not done before planting and few producers cultivate no-till fields after planting. The purpose of a burndown herbicide application is to ensure that the crop is planted into a weed-free setting. No-till soybean fields are more likely to need a burn-

down application than corn because soybean are planted later. Check fields carefully to determine if such a treatment is needed. Give particular attention to perennial weeds like dandelion, white cockle, and quackgrass as well as winter annuals like horseweed (aka marestail), shepherd's purse, chickweeds, buttercups, and pennycress.

## PRE-emergence herbicides

With the widespread occurrence of weed resistance to glyphosate and other commonly used POST-emergence soybean herbicides such as ALS-inhibitors (Group 2; Pursuit, FirstRate, Classic, etc.) and PPO-inhibitors (Group 14; Cobra, Flextar, Cadet, etc.), the use of PRE-emergence herbicides become of extreme importance in soybean production.

Research conducted across the Midwest has demonstrated the importance of keeping a soybean crop weed-free from establishment through the V3 growth stage (3rd trifoliate). Weeds emerging after the V3 growth stage will likely not impact soybean yield; however, they should still be proactively managed to prevent them from reproducing and replenishing the seedbank (remember "no seed, no weed"). Thus, PRE-emergence herbicides can help farmers maintain their fields weed-free during initial establishment of the crop (= achieve full yield potential) and also reduce the selection pressure on POST-emergence herbicides (due to fewer weeds to be controlled POST-emergence), helping on the fight against herbicide resistance.

Several PRE-emergence herbicides are available for use in soybeans (see Table 3-1a). Most of them can be applied before or up to 3 days after planting. To maximize their residual

activity in-season, PRE-emergence herbicides should be sprayed at or shortly after planting. PRE-emergence herbicides need moisture for incorporation and activation in the soil. If there are established weeds at the time of PRE-emergence application and no additional pre-plant field cultivation will take place, it's important to have an effective burndown herbicide in the tank-mix. A PRE-emergence herbicide containing 2 or more effective sites of action (SOA) will likely provide control of a wider range of weed species when compared to the use of a single SOA. Using multiple SOA during each pass is also a proactive strategy for herbicide resistance management.

It's important to note that under cool and wet conditions, PRE-emergence herbicides containing metribuzin (Group 5; Sencor, Tricor) and/or PPO-inhibitors (Group 14; Sharpen, Spartan, Valor, etc.) may cause some crop injury, particularly in lighter soils with low OM and/or higher pH. However, the benefit of an early-season weed-free field outweighs the concerns of early-season crop injury (assuming a herbicide is applied according to the label and no significant stand reduction is observed).

**Table 3-1a.** Weed control ratings of soybean herbicides applied before emergence or via pre plant incorporation<sup>a</sup>

Herbicides	Site of action group <sup>b</sup>	Risk of soybean injury	Grasses							Broadleaves							Perennials						
			Barnyardgrass	Crabgrass	Fall panicum	Field sandbur	Foxtails	Wild proso millet	Woolly cupgrass	Cocklebur	Common ragweed	Eastern black nightshade	Giant ragweed	Lambsquarters	Pigweeds	ALS & Gly-R Waterhemp <sup>c</sup>	Smartweeds	Velvetleaf	Canada thistle	Dandelion	Hemp dogbane	Nutsedge	Quackgrass
Preplant–incorporated (PPI)			Many herbicides can also be preplant-incorporated with small changes in effectiveness.																				
Prowl H2O	3	1	8	9	9	8	9	7	7	4	0	4	0	8	9	7	4	4	0	0	0	0	0
Treflan	3	1	9	9	9	8	9	7	7	4	0	5	0	8	9	8	4	4	0	0	0	0	0
Preemergence (PRE)																							
Afforia	2,14	4	5	5	5	6	5	5	5	7	8	9	5	9	9	8	7	8	7	7	5	5	0
Anthem/ Anthem Maxx	14,15	2	9	9	9	6	9	7	7	0	6	8	0	8	8	8	—	6	0	0	0	6	—
Authority Assist	2,14	3	7	7	7	5	8	6	5	7	7	9	6	9	9	9	9	9	5	5	5	7	5
Authority Elite/ Broadaxe XC	14,15	2	9	9	9	6	9	7	7	5	6	8	5	9	9	9	7	7	5	5	5	8	0
Authority First/ Sonic	2,14	2	5	7	5	0	5	0	0	8	9	8	8	9	9	9	9	8	5	5	5	7	0
Authority Maxx/ Authority XL	2,14	2	5	5	5	5	5	0	0	7	8	8	7	9	9	9	8	8	5	6	5	5	0
Authority MTZ/ Preview 2.1SC	5,14	3	6	6	6	4	6	4	4	6	7	8	7	9	9	8	9	7	5	5	5	7	5
Authority Su- preme/Edge	14,15	2	8	8	8	6	8	7	6	5	6	8	5	9	9	9	7	7	—	—	—	8	—
Boundary/ Tailwind	14,15	3	9	9	9	6	9	7	7	6	7	8	6	9	9	8	8	8	5	5	5	8	5
Canopy/ Canopy Blend	2,6	2	5	5	5	—	5	—	—	8	8	—	7	9	9	6	8	9	6	7	—	—	—
Canopy EX	2,2	2	5	5	5	5	5	5	5	8	8	6	7	9	8	4	8	8	5	—	—	5	5
Dual II Magnum/ Cinch/Moccasin	15	1	9	9	9	6	9	7	7	0	5	8	5	7	8	8	5	5	0	0	0	8	0
Enlite/Envive	2, 14	2	5	5	5	5	5	—	—	9	9	9	7	9	9	8	8	8	—	9	—	—	—
Fierce/Fierce EZ	14,15	3	9	9	9	6	9	7	7	5	7	9	5	9	9	9	7	7	5	5	5	6	—
Fierce MTZ/Kyber	5,14,15	4	9	9	9	6	9	7	7	7	8	9	6	9	9	9	8	8	5	5	5	5	—
Fierce XLT	2,14,15	4	9	9	9	6	9	7	7	8	8	9	7	9	9	9	9	9	5	5	5	6	—
FirstRate	2	2	4	4	4	0	4	0	0	8	9	4	8	8	9	4	8	8	0	—	—	0	0

Risk of soybean injury: 6 = high; 4 = moderate; 2 = slight; 1 = very slight; 0 = none

Control ratings: 10 = excellent; 8 = good; 6 = fair; 4 = poor; 0 = none; — = insufficient information

<sup>a</sup>These herbicides have been rated for expected weed control, but actual results may vary depending upon rates applied, soil types, weather conditions, and crop management.

<sup>b</sup>Weed Science Society of America-approved group numbers for the corresponding herbicide site of action.

<sup>c</sup>ALS & Gly-R Waterhemp = ratings for confirmed ALS and glyphosate-resistant waterhemp populations.

Continued on next page

Principles of pest  
management

Corn

Soybean weeds

Forages &  
pastures

Small grains

Stored grain  
insects

Appendix

**Table 3-1a.** Weed control ratings of soybean herbicides applied before emergence or via pre plant incorporation<sup>a</sup> (continued)

Herbicides	Site of action group <sup>b</sup>	Risk of soybean injury	Grasses							Broadleaves							Perennials						
			Barnyardgrass	Crabgrass	Fall panicum	Field sandbur	Foxtails	Wild proso millet	Woolly cupgrass	Cocklebur	Common ragweed	Eastern black nightshade	Giant ragweed	Lambsquarters	Pigweeds	ALS & Gly-R Waterhemp <sup>c</sup>	Smartweeds	Velvetleaf	Canada thistle	Dandelion	Hemp dogbane	Nutsedge	Quackgrass
Lorox	7	3	6	6	6	5	6	5	5	6	8	7	6	9	9	7	9	7	5	5	0	0	0
metribuzin	5	3	6	5	6	4	6	5	4	6	7	5	6	9	9	8	8	8	5	5	5	5	5
Outlook	15	1	9	9	9	7	9	7	7	5	5	8	5	7	8	8	5	5	0	0	0	7	0
Panther PRO	2,5,14	2	7	7	7	—	7	6	5	7	8	9	7	9	9	8	9	9	—	—	—	—	—
Prefix	14,15	2	8	8	8	6	8	7	7	4	7	9	5	8	9	8	6	6	5	5	5	6	0
Pursuit	2	1	7	7	7	—	7	6	5	7	7	9	7	9	9	4	9	9	0	5	5	0	5
Python	2	1	0	0	0	0	0	0	0	7	7	8	5	8	8	4	8	8	0	5	5	0	0
Sharpen	14	2	5	5	5	5	5	5	5	5	7	8	7	8	8	7	7	7	5	6	5	5	0
Spartan/ Shutdown	14	2	6	6	6	4	6	4	4	5	6	8	5	9	9	8	7	7	—	—	—	8	—
Surveil	2,14	3	6	6	6	5	6	5	5	8	9	8	8	9	9	8	9	8	5	7	5	5	0
Tendovo	2, 5, 15	3	9	9	9	6	9	7	7	8	9	8	8	9	9	8	8	8	5	5	5	8	5
Trivence	2,5,14	4	6	6	6	5	6	5	4	7	8	8	7	9	9	8	8	8	5	6	6	6	5
Valor SX	14	3	6	6	6	5	6	5	5	5	8	9	5	9	9	8	7	7	5	6	5	5	0
Valor XLT	2,14	3	6	6	6	5	6	5	5	8	8	9	7	9	9	8	9	9	5	6	5	5	0
Verdict	14,15	2	5	5	5	5	6	5	5	5	7	8	7	8	8	8	7	7	5	6	5	5	0
Warrant	15	2	9	9	9	8	9	8	7	5	6	8	5	7	8	7	5	5	0	0	0	7	0
Warrant Ultra	14, 15	2	9	9	9	8	9	8	7	5	7	9	5	8	9	8	6	6	7	7	5	7	9
Zidua/Zidua SC	15	2	9	9	9	7	9	7	7	5	6	8	6	8	8	8	5	6	0	0	0	6	—
Zidua PRO	2,14,15	2	9	9	9	6	9	7	7	7	7	9	6	9	9	8	9	9	0	0	0	6	—

Risk of soybean injury: 6 = high; 4 = moderate; 2 = slight; 1 = very slight; 0 = none

Control ratings: 10 = excellent; 8 = good; 6 = fair; 4 = poor; 0 = none; — = insufficient information

<sup>a</sup>These herbicides have been rated for expected weed control, but actual results may vary depending upon rates applied, soil types, weather conditions, and crop management.

<sup>b</sup>Weed Science Society of America-approved group numbers for the corresponding herbicide site of action.

<sup>c</sup>ALS & Gly-R Waterhemp = ratings for confirmed ALS and glyphosate-resistant waterhemp populations.

**Table 3-1b.** Weed control ratings of soybean herbicides applied after soybean emergence<sup>a</sup>

Postemergence Herbicides	Site of action group <sup>b</sup>	Risk of soybean injury	Grasses									Broadleaves									Perennials				
			Barnyardgrass	Crabgrass	Fall panicum	Field sandbur	Foxtails	Volunteer corn	Wild proso millet	Woolly cupgrass	Cocklebur	Common ragweed	Eastern black nightshade	Giant ragweed	Lambsquarters	Pigweeds	ALS & Gly-R Waterhemp <sup>c</sup>	Smartweeds	Velvetleaf	Canada thistle	Dandelion	Hemp dogbane	Nutsedge	Quackgrass	
Anthem/Anthem Maxx <sup>d</sup>	14, 15	3	2	2	2	2	2	0	2	2	5	5	6	5	8	8	7	5	9	5	5	5	0	—	
Assure II/Targa	1	0	9	9	9	9	8	9	9	8	0	0	0	0	0	0	0	0	0	0	0	0	0	9	
Basagran	6	2	0	0	0	0	0	0	0	0	9	7	4	6	7	5	4	9	9	7	5	5	8	0	
Cadet	14	3	2	2	2	2	2	0	2	2	5	5	6	5	8	8	7	5	9	5	5	5	0	0	
Classic	2	2	0	0	0	0	0	7	0	0	9	8	3	8	5	9	4	8	8	7	5	5	8	0	
Cobra/Phoenix	14	5	4	5	5	5	3	0	3	3	8	9	8	8	6	9	8	7	7	7	5	7	5	0	
dicamba <sup>e</sup>	4	1	0	0	0	0	0	0	0	9	8	9	8	9	8	9	8	8	7	8	8	8	0	0	
Enlist One <sup>f</sup>	4	1	0	0	0	0	0	0	0	0	9	9	7	8	9	9	8	7	8	8	7	8	0	0	
Enlist Duo <sup>f</sup>	4,9	0	9	9	9	9	9	9	9	9	9	9	9	9	9	9	4	8	9	9	7	9	8	9	
Extreme <sup>g</sup>	2,9	1	9	9	9	9	9	9	9	9	9	9	9	8	9	9	4	9	9	8	7	8	8	9	
FirstRate	2	2	0	0	0	0	0	5	0	0	9	9	0	9	5	5	4	8	8	7	—	—	7	0	
Flexstar	14	4	4	4	4	4	4	5	4	4	8	9	8	8	7	9	8	8	7	7	5	5	0	0	
Flexstar GT 3.5 <sup>g</sup>	9,14	4	9	9	9	9	9	9	9	9	9	9	9	9	9	9	8	9	9	9	7	9	8	9	
Fusilade DX	1	0	9	9	9	8	8	9	9	8	0	0	0	0	0	0	0	0	0	0	0	0	0	9	
Fusion	1	0	9	9	9	8	9	9	9	8	0	0	0	0	0	0	0	0	0	0	0	0	0	8	
glyphosate <sup>g</sup>	9	0	9	9	9	9	9	9	9	9	9	9	9	9	9	9	4	8	9	9	7	9	8	9	
glufosinate <sup>h</sup>	10	1	7	8	8	6	8	7	8	7	9	9	8	8	8	8	8	9	8	7	8	7	5	6	
Harmony SG <sup>i</sup>	2	4	0	0	0	0	0	0	0	0	6	5	0	5	9	9	4	9	9	5	5	5	—	0	
Marvel	14	5	5	5	5	5	5	5	5	5	8	9	8	7	8	9	8	8	9	6	6	5	0	0	
Poast/Poast Plus	1	0	9	9	9	9	9	8	9	8	0	0	0	0	0	0	0	0	0	0	0	0	0	8	
Prefix <sup>d</sup>	14,15	4	4	4	4	4	4	5	4	4	8	9	8	8	7	9	8	8	7	7	5	5	0	0	
Pursuit	2	2	7	7	7	5	8	6	5	6	9	7	9	7	5	9	4	8	9	7	5	5	0	6	
Raptor	2	3	7	7	7	7	9	6	8	6	9	8	9	8	8	9	4	8	9	7	—	—	0	6	
Resource	14	4	2	2	2	2	2	0	2	2	7	8	4	6	7	7	6	5	9	5	5	5	—	5	

Risk of soybean injury: 6 = high; 4 = moderate; 2 = slight; 1 = very slight; 0 = none

Control ratings: 10 = excellent; 8 = good; 6 = fair; 4 = poor; 0 = none; — = insufficient information

<sup>a</sup> These herbicides have been rated for expected weed control, but actual results may vary depending upon rates applied, soil types, weather conditions, and crop management.<sup>b</sup> Weed Science Society of America-approved group numbers for the corresponding herbicide site of action.<sup>c</sup> ALS & Gly-R Waterhemp = ratings for confirmed ALS and glyphosate-resistant waterhemp populations.<sup>d</sup> Ratings indicate the level of control of weeds that are emerged at the time of application. Refer to Table 3-1a for the residual weed control provided by these products.<sup>e</sup> Apply to dicamba-tolerant soybeans only: Xtendimax, Engenia, and Tavium are the only dicamba herbicides approved for this use.<sup>f</sup> Apply to Enlist<sup>TM</sup> soybeans only.<sup>g</sup> Apply to glyphosate-tolerant soybeans only.<sup>h</sup> Apply to glufosinate-tolerant soybeans only.<sup>i</sup> Risk of injury on STS<sup>®</sup> and BOLT<sup>TM</sup> soybeans is minimal.<sup>j</sup> Ratings indicate the level of control of weeds that are emerged at the time of application. Refer to Dual II Magnum in Table 3-1a for the residual weed control provided by these products.

Continued on next page

**Table 3-1b.** Weed control ratings of soybean herbicides applied after soybean emergence<sup>a</sup> (continued)

Postemergence Herbicides	Site of action group <sup>b</sup>	Risk of soybean injury	Grasses									Broadleaves									Perennials				
			Barnyardgrass	Crabgrass	Fall panicum	Field sandbur	Foxtails	Volunteer corn	Wild proso millet	Woolly cupgrass	Cocklebur	Common ragweed	Eastern black nightshade	Giant ragweed	Lambsquarters	Pigweeds	ALS & Gly-R Waterhemp <sup>c</sup>	Smartweeds	Velvetleaf	Canada thistle	Dandelion	Hemp dogbane	Nutsedge	Quackgrass	
Select Max	1	0	9	9	9	9	9	9	9	8	0	0	0	0	0	0	0	0	0	0	0	0	0	8	
Sequence <sup>g,j</sup>	9,15	1	9	9	9	9	9	9	9	9	9	9	9	9	9	9	4	8	9	9	7	9	8	9	
Synchrony XP <sup>i</sup>	2	4	0	0	0	0	0	6	0	0	9	8	3	8	8	9	4	9	9	5	5	5	5	0	
Tavium <sup>e,j</sup>	4,15	1	0	0	0	0	0	0	0	9	8	9	8	9	8	9	8	8	7	8	8	8	0	0	
Ultra Blazer	14	4	2	4	4	4	2	2	2	2	7	8	8	8	5	9	8	9	7	5	5	7	5	0	
Warrant Ultra <sup>d</sup>	14, 15	4	4	4	4	4	4	5	4	4	8	9	8	8	7	9	8	8	7	7	5	5	0	0	

Risk of soybean injury: 6 = high; 4 = moderate; 2 = slight; 1 = very slight; 0 = none

Control ratings: 10 = excellent; 8 = good; 6 = fair; 4 = poor; 0 = none; — = insufficient information

<sup>a</sup> These herbicides have been rated for expected weed control, but actual results may vary depending upon rates applied, soil types, weather conditions, and crop management.

<sup>b</sup> Weed Science Society of America-approved group numbers for the corresponding herbicide site of action.

<sup>c</sup> ALS & Gly-R Waterhemp = ratings for confirmed ALS and glyphosate-resistant waterhemp populations.

<sup>d</sup> Ratings indicate the level of control of weeds that are emerged at the time of application. Refer to Table 3-1a for the residual weed control provided by these products.

<sup>e</sup> Apply to dicamba-tolerant soybeans only: Xtendimax, Engenia, and Tavium are the only dicamba herbicides approved for this use.

<sup>f</sup> Apply to Enlist™ soybeans only.

<sup>g</sup> Apply to glyphosate-tolerant soybeans only.

<sup>h</sup> Apply to glufosinate-tolerant soybeans only.

<sup>i</sup> Risk of injury on STS® and BOLT™ soybeans is minimal.

<sup>j</sup> Ratings indicate the level of control of weeds that are emerged at the time of application. Refer to Dual II Magnum in Table 3-1a for the residual weed control provided by these products.

## Soybean herbicides

### 2,4-D Amine, 2,4-D LV ester, 2,4-D acid 2,4-D (4)

\*There are many brands and formulations of 2,4-D available for use. Application rates, adjuvant recommendations, and other guidelines for use may vary among 2,4-D products. Consult product labels for more specific product use guidelines and restrictions.

**Rate:** 0.5-1 lb acid equivalent/a. For 3.8 lb ae/gal formulations (LV4/Amine4) – 1-2.1 pt/a. For 5.6 lb ae/gal formulations (LV6/Amine6) – 0.7-1.43 pt/a.

**Adjuvants:** Add COC at 1% v/v OR NIS at 0.25% v/v to improve control of large or difficult to control weeds.

**Crop Stage:** Apply preplant only. 2,4-D amine: 0.5 lb ae/a – no less than 15 days preplant (PP); 1 lb ae/a – no less than 30 days PP. 2,4-D ester/2,4-D acid: 0.5 lb ae/a – no less than 7 days PP; 1 lb ae/a – no less than 15 days PP.

**Weed timing:** Will only control emerged broadleaf weeds. Annual broadleaf weeds are controlled best when less than 3 inches tall. Perennial broadleaves should be in the bud stage for the best control.

**NO-TILL:** Apply before no-till soybean planting for the suppression or control of small, actively growing broadleaf weeds. This treatment can be used to control broadleaf weeds that aren't effectively controlled by Gramoxone or glyphosate. This treatment may be tank mixed with many conservation-tillage soybean treatments for improved broadleaf weed control.

**Remarks:** There is some risk of soybean injury, especially if heavy rains occur after application. Do not apply 2,4-D before planting unless you are prepared to accept soybean injury including possible stand loss and/or yield reduction in some years. Plant soybean 1-2 inches deep, and make certain the seed is adequately covered. Do not use on sandy soils with less than 1% organic matter. Do not cultivate between herbicide application and soybean planting.

### Afforia flumioxazin (14) + thifensulfuron (2) + tribenuron (2)

**Rate:** 2.5-3.75 oz/a; Apply no more than 2.5 oz/a if treating at least 1 day prior to planting. Rates of up to 3.75 oz/a can be used if applying at least 7 days prior to planting.

**Adjuvants:** Add crop oil concentrate or methylated seed oil at 1% unless tank mix herbicide label doesn't allow then use a nonionic surfactant at 0.25%.

**Crop stage:** Do not apply to soybean that have either cracked or emerged as severe injury will occur.

**Weed timing:** Tank mix other herbicides to control emerged weeds, if weed size exceeds 3 inches. Provides two modes of action for residual broadleaf and partial grass suppression. For season-long control of grasses POST treatments will be needed.

**Remarks:** Rate for application should be based on soil characteristics as well as the most difficult weed to control being targeted. Label recommends including 2,4-D in burndown treatment. Do not tank mix or apply any Organophosphate insecticides at planting or within 14 days of planting or injury may result. See label for additional restrictions with respect to other herbicide uses in fields treated with this product.

### Anthem pyroxasulfone (15) + fluthiacet-methyl (14)

**Rate:** 4-11 fl oz/a; Rates are based on % organic matter, soil texture and application timing. See label for details. If a large amount of residue exists or for early preplant applications, use the higher end of the rate range.

**Adjuvants:** Add either COC or MSO at 1-2 pt/a or NIS at 0.25% if weeds are emerged at application.

**Crop stage:** Apply from up to 45 days preplant through the V3 soybean growth stage. For PPI applications incorporate into the upper 1-2" of soil up to 14 days before planting.

**Weed Timing:** See info under Anthem Maxx.

**Remarks:** See info under Anthem Maxx.

### Anthem Maxx pyroxasulfone (15) + fluthiacet-methyl (14)

**Rate:** 2.0-5.7 fl oz/a; Rates are based on % organic matter, soil texture and application timing. See label for details. If a large amount of residue exists or for early preplant applications, use the higher end of the rate range.

**Adjuvants:** Add either COC or MSO at 1-2 pt/a or NIS at 0.25% if weeds are emerged at application. UAN at 1-2 qts/a or AMS at 8.5-17 lb/100 gal may also be added.

**Crop stage:** Apply from up to 45 days preplant through the V6 soybean growth stage. For PPI applications incorporate into the upper 1-2" of soil up to 14 days before planting.

**Weed Timing:** Anthem Maxx provides residual control of many grass and broadleaf species. Anthem Maxx will also control or suppress certain emerged broadleaf weeds. Applications to weeds larger than specified on the label can result in unsatisfactory control. Will not control emerged grasses. For enhanced control of emerged weeds use Anthem Maxx in combination with other labeled herbicides.

**Remarks:** Anthem Maxx can be applied in sequen-

tial programs but do exceed the maximum use rate per year. Separate sequential applications by at least 14 days.

### Assure II quizalofop (1)

**Rate:** 5-12 fl oz/a; To control volunteer Roundup Ready corn, use 4 fl oz/a for 12-inch tall corn, 5 fl oz/a for 12-18-inch corn, and 8 fl oz/a for 18-30-inch corn.

**Adjuvants:** Add either crop oil concentrate at 1% (2% under arid conditions) or nonionic surfactant at 0.25%. An ammonium nitrogen fertilizer may be added but is not required to optimize performance. 2-4 qt/a UAN or 2-4 lb/a AMS. Use higher rates under arid conditions.

**Crop stage:** Apply any time after emergence until soybean pod set or up to 80 days before harvest.

**Weed Timing:** Controls emerged actively growing grasses only. Adjust rate depending on size and species of grass present. Can be tank mixed with other broadleaf or broad-spectrum herbicides, but grass control may be reduced. To avoid potential antagonism, increase the rate of Assure II or apply in a separate application. In sequential applications, apply 1 day before or 7 days after the broadleaf herbicide.

**Remarks:** Do not make more than two applications per season. Will not control volunteer corn with the Enlist trait.

### Authority Assist sulfentrazone (14) + imazethapyr (2)

**Rate:** 6-12 fl oz/a; Rate dependent on % organic matter and soil texture. See label for details. Reduced rates of 4-6 fl oz/a can be used in conjunction with a planned follow up application of glufosinate, glyphosate, dicamba, or 2,4-d on the appropriate GMO soybean variety. Reduced rates are not advisable when managing herbicide resistant or tough to control weeds like waterhemp.

**Crop stage:** Apply from 45 days before planting up to 3 days after planting. Do not apply if soybean seedlings are emerging.

**Weed Timing:** Provides residual control/suppression of many broadleaf weeds and suppression of some grass species. Authority Assist can be tank mixed with other preemergence grass herbicides to improve grass control. The length of residual activity will depend on the rate used.

**Remarks:** Heavy rains after application or cold, wet soils may increase the risk of injury. Do not apply to sands with less than 1% organic matter. The seed furrow must be closed prior to application or crop injury may result.

### Authority Edge sulfentrazone (14) + pyroxasulfone (15)

**Rate:** 5.9-15.7 fl oz/a. Rates are based on soil

texture and % organic matter, see label of each product for details.

**Crop Stage:** Fall, preplant (up to 30 days before planting), PRE (within 3 days of planting). For PPI applications, incorporate into the upper 1-2" of soil. Do not apply if soybean seedlings are emerging.

**Weed Timing:** Provides residual control/suppression of labeled broadleaf and grass weeds. Authority Supreme will not adequately control emerged weeds. Use an appropriate tank mix partner if weeds are emerged at the time of application.

**Remarks:** Similar product as Authority Supreme but with a higher sulfentrazone to pyroxasulfone, ratio (1.8:1). Authority Supreme has a 1:1 ratio. Can be applied in a sequential program but do not exceed the maximum use rate per year, coarse soils: 9.42 fl oz/a; medium and fine soils: 15.7 fl oz/a. Do not make more than 2 applications per year and do not apply within 7 days of a previous application. Heavy rains after application, cold, wet soils, may increase the risk of injury. The seed furrow must be closed prior to application or crop injury may result

**Authority Elite** sulfentrazone (14) +  
S-metolachlor (15)

**Rate:** 19-38.7 oz/a. Rate dependent on % soil organic matter and texture. See label for details. For soils with pH greater than 7.2, use the lowest rate for that specific soil texture and organic matter.

**Crop stage:** Apply before planting or within 3 days after planting. For PPI applications incorporate into the upper 1-2" of soil with 14 days of planting. Do not apply if soybean seedlings are emerging.

**Weed Timing:** Provides residual control/suppression of many broadleaf and grass weeds. The length of residual activity will depend on the rate used. Will not adequately control emerged weeds.

**Remarks:** Do not use on sandy soils which have <1% organic matter. Heavy rains after application or cold, wet soils may increase the risk of injury. Do not apply more than 38.7 fl oz/a per year. Apply on coarse soils no more than 2 weeks before planting.

**Authority First** sulfentrazone (14) +  
cloransulam (2)

**Rate:** 6.45-8 oz/a; Rate dependent on % organic matter. See label for details. Reduced rates of 3-6 oz/a can be used in conjunction with a planned follow up application of glufosinate, glyphosate, dicamba, or 2,4-d on the appropriate GMO soybean variety. Reduced rates are not advisable when managing herbicide resistant or tough to control weeds like waterhemp.

**Adjuvants:** Add NIS at 0.25% v/v plus AMS at 2.5% v/v in burndown applications. COC or MSO at 1.2% v/v may also be used instead of NIS.

**Crop stage:** Apply before planting or within 3 days after planting. For PPI applications, incorporate into the upper 1-3" of soil within 14 days of planting. Do not apply if soybean seedlings are emerging.

**Weed Timing:** Provides residual control/suppression of many broadleaf and grass weeds. The length of residual activity will depend on the rate used. At full rates, annual grasses will be suppressed, but will likely need to be controlled postemergence. Can be tank mixed with other preemergence grass herbicides to improve grass control. At the full rate, Authority First can provide for increased burndown activity of some broadleaf weeds up to 3" tall in no-till applications. However, it is not intended to replace an appropriate preplant burndown program.

**Remarks:** Do not apply to sands with less than 1% organic matter. The seed furrow must be closed prior to applying this premix or crop injury may result.

**Authority MTZ** sulfentrazone (14) +  
metribuzin (5)

**Rate:** 12-20 oz/a; Rate dependent on % organic matter and soil texture. See label for details. Reduced rates of 8-14 oz/a can be used in conjunction with a planned follow up application of glufosinate, glyphosate, dicamba, or 2,4-d on the appropriate GMO soybean variety. Reduced rates are not advisable when managing herbicide resistant or tough to control weeds like waterhemp.

**Adjuvants:** Add NIS at 0.25% v/v or COC at 1 qt/a in burndown applications to enhance control of emerged weeds.

**Crop stage:** Apply from 45 days before planting up to 3 days after planting. For PPI applications, do not incorporate deeper than 2 inches into the soil. Do not apply if soybean seedlings are emerging.

**Weed Timing:** Provides residual control/suppression of many broadleaf weeds and suppression of some grass species. Authority MTZ can be tank mixed with other preemergence grass herbicides to improve grass control. The length of residual activity will depend on the rate used. Authority MTZ can provide for increased burndown activity of some broadleaf weeds up to 3" tall in no-till applications. However, it is not intended to replace an appropriate preplant burndown program.

**Remarks:** Do not apply to sands with less than 1% organic matter. Heavy rains after application, cold, wet soils, or soils with a pH greater than 7.5 may increase the risk of injury. The seed furrow must be closed prior to application or crop injury may result.

**Authority Maxx** sulfentrazone (14) +  
chlorimuron (2)

**Rate:** 5.0-9.6 oz/a; Rates are based on % organic

matter and soil texture. See label for details. If a large amount of residue exists use the higher end of the rate range.

**Adjuvants:** Add COC or MSO at 1% v/v or NIS at 0.25% v/v in burndown applications to enhance control of emerged weeds. The use of AMS or another nitrogen source may also enhance burndown applications.

**Crop Stage:** Apply before planting or within 3 days after planting. For PPI applications, do not incorporate deeper than 2 inches into the soil. Do not apply if soybean seedlings are emerging.

**Weed Timing:** Provides residual control/suppression of many broadleaf weeds and suppression of some grass species. Authority Maxx can be tank mixed with other preemergence grass herbicides to improve grass control. The length of residual activity will depend on the rate used. Authority Maxx can provide for increased burndown activity of some broadleaf weeds up to 3" tall in no-till applications. However, it is not intended to replace an appropriate preplant burndown program.

**Remarks:** Do not apply to sands with less than 1% organic matter. Do not apply to soils with a pH greater than 7.6. The seed furrow must be closed prior to application or crop injury may result.

**Authority Supreme** sulfentrazone (14)  
+ pyroxasulfone (15)

**Rate:** 6.0-11.5 fl oz/a. Rates are based on soil texture and % organic matter, see label of each product for details.

**Crop Stage:** Fall, preplant (up to 30 days before planting), PRE (within 3 days of planting). For PPI applications, incorporate into the upper 1-2" of soil. Do not apply if soybean seedlings are emerging.

**Weed Timing:** Provides residual control/suppression of labeled broadleaf and grass weeds. Authority Supreme will not adequately control emerged weeds. Use an appropriate tank mix partner if weeds are emerged at the time of application.

**Remarks:** Similar product as Authority Edge but with a lower sulfentrazone to pyroxasulfone, ratio (1:1). Authority Edge has a 1.8:1 ratio. Can be applied in a sequential program but do not exceed the maximum use rate per year, coarse soils: 6.9 fl oz/a; medium and fine soils: 11.5 fl oz/a. Do not make more than 2 applications per year and do not apply within 7 days of a previous application. Heavy rains after application, cold, wet soils, may increase the risk of injury. The seed furrow must be closed prior to application or crop injury may result.

**Autumn Super 51 WDG** iodosulfuron (2)  
+ thienencarbazone (2)

**Rate:** 0.5 oz/a

**Adjuvants:** COC, MSO, N, AMS. Add 1% crop oil concentrate or methylated seed oil and either 1.5–2 qt/a 28% urea ammonium nitrate or 1.5–3.0 lb/a ammonium sulfate.

**Crop stage:** Apply in the fall after harvest or 60 days before planting soybean in the spring.

**Remarks:** Is intended to provide fall burndown control and limited residual activity on broadleaf weeds including alfalfa, plantain, dandelion, horseweed, and several mustard species. The label recommends application to certain broadleaf weeds up to 3 inches and annual grasses no greater than 1 inch in height. However, it can be tank mixed with 2,4-D, glyphosate, dicamba, paraquat, or metribuzin for enhanced burndown activity and increased weed spectrum and sizes consistent with the label of the tank-mix partner. The 30-day interval between application and corn planting will primarily limit use to fall applications. It is rainfast in 2 hours. Do not apply to frozen soil or soil with pH greater than 8.0.

### Basagran bentazon (6)

**Rate:** 1–2 pt/a

**Adjuvants:** COC. Add 1 qt/a of crop oil concentrate in the final spray mixture.

**Crop stage:** Applications are generally made from the unifoliate to second trifoliate leaf stage.

**Remarks:** Soybean are quite tolerant of Basagran but slight leaf yellowing, bronzing, speckling, or burn may occur. Soybean generally outgrow this condition within 10 days. Soybean leaf burn increases when using nitrogen solution, but new soybean growth is normal and crop vigor is not reduced. Because Basagran has contact action, weeds must be thoroughly covered with spray. Do not apply if wind exceeds 10 mph.

### Boundary 6.5 EC S-metolachlor (15) + metribuzin (5)

**Rate:** 1.2–3.0 pt/a. Rate dependent on % organic matter and soil texture, see label for details. Rates of 1.5–1.8 pt/a can be used in conjunction with a planned follow up POST application of glufosinate, glyphosate, dicamba, or 2,4-d on the appropriate GMO soybean variety.

**Adjuvants:** The use of an adjuvant is only necessary in burndown applications with certain tank-mix partners. Consult the labels of all products in the tank-mix for adjuvant recommendations.

**Crop stage:** Apply from 30 days before planting up to 3 days after planting. For PPI applications, incorporate into the top 2 inches of soil within 14 days before planting.

**Weed timing:** Provides residual control/suppression of many annual broadleaves and grasses.

Length of residual control will depend on the rate used. Boundary can be tank mixed with many other PRE soybean herbicides to broaden the spectrum of control and to increase the length of residual. The metribuzin component of Boundary will also provide enhanced burndown control of several broadleaves. Burndown applications should include an appropriate tank mix partner (see label for recommendations).

**Remarks:** Boundary may injure soybean because of the metribuzin component. The risk of soybean injury increases when soybeans are planted less than 1.5 inches deep or when heavy rains follow application. Use should be avoided on soils with less than 0.5% organic matter, on soils with a pH of 7.5 or higher, and in fields where residues of atrazine exist. Do not use on sand regardless of organic matter or on loamy sand with less than 2% organic matter. Limit the rate of Boundary to 1.5 pt/a on soils with a pH above 7. Check the label for a list of metribuzin-sensitive soybean varieties.

### Broadaxe XC sulfentrazone (14) + S-metolachlor (15)

**Rate:** 19–38.7 oz/a. Rate dependent on % soil organic matter and texture. See label for details. For soils with pH greater than 7.2, use the lowest rate for that specific soil texture and organic matter.

**Crop stage:** Apply before planting or within 3 days after planting. For PPI applications incorporate into the upper 1–2" of soil with 14 days of planting. Do not apply if soybean seedlings are emerging.

**Weed Timing:** Provides residual control/suppression of many broadleaf and grass weeds. The length of residual activity will depend on the rate used. Will not adequately control emerged weeds.

**Remarks:** Do not apply more than 38.7 fl oz/a per year. Do not apply greater than 0.375 lb ai/a of sulfentrazone or greater than 2.387 lb ai/a metolachlor per season to the field. Do not apply to soils classified as sand with less than 1% organic matter. Apply on coarse soils no more than 2 weeks before planting. Heavy rains after application or cold, wet soils may increase the risk of injury.

### Cadet fluthiacet-methyl (14)

**Rate:** 0.4–0.9 fl oz/a; 0.4–0.6 fl oz/a in glyphosate mixtures or 0.6–0.9 fl oz/a if applied alone or in other tank mixtures.

**Adjuvants:** NIS, COC, N, AMS. Add nonionic surfactant at 0.25% or crop oil concentrate at 1–2 pt/a to the spray solution. Add 28% nitrogen solution at 1–2 qt/a or ammonium sulfate at 1–2 lb/a. If mixed with a fully loaded glyphosate, only add ammonium sulfate.

**Crop stage:** Apply from first trifoliate to full flower

stage.

**Remarks:** Cadet may cause temporary speckling of soybean leaves. Cadet has contact activity and requires good spray coverage with a minimum of 15 gal/a spray volume and 20 psi spray pressure. It is an option when targeting velvetleaf alone or to improve the control of other broadleaf herbicides. Do not apply if wind speed exceeds 10 mph.

### Canopy Blend metribuzin (5) + chlorimuron (2)

**Rate:** 2.9 oz/a

**Adjuvants:** Add COC at 1% v/v in burndown applications or NIS at 0.25% v/v if tank-mixed with glyphosate.

**Crop stage:** Apply up to 45 days before planting or within 3 days after planting. For PPI application, incorporation must be uniform and no deeper than 1–2 inches.

**Weed timing:** Will provide early season residual control of many annual broadleaf weeds like lambsquarters, pigweed, common ragweed, smartweed, and velvetleaf and suppression of foxtails and crabgrasses. Canopy can be mixed with a preemergence herbicide or followed by a postemergence herbicide for a complete weed control program. Canopy Blend can also be used as part of a burndown program in no-till applications. Canopy Blend can be tank mixed with Assure II, glyphosate, Gramoxone, or 2,4-D. If mixed with 2,4-D, planting must be delayed 7 days after application.

**Remarks:** Can only be used south of I-90 between La Crosse and Madison and south of I-94 between Madison and Milwaukee. Do not use on soils that exceed a soil pH of 7.6.

### Canopy EX chlorimuron (2) + tribenuron (2)

**Rate:** 1.1 oz/a Canopy EX + 1 pt/a 2,4-D

**Adjuvants:** Apply 1% v/v crop oil concentrate OR 0.25% v/v nonionic surfactant, if crop oil concentrate is prohibited by a tank-mix partner.

**Crop stage:** Apply in the fall or spring at least 7 days before planting soybean.

**Weed timing:** Provides burndown control of dandelions plus several winter annual broadleaves such as mustards (field pennycress, shepherd's purse, etc.), common chickweed, henbit, and horseweed. Will provide residual weed control depending on application timing. Other herbicides such as Assure II, glyphosate, Gramoxone, or Metribuzin can be tank mixed to control additional grass or broadleaf weeds. Can add 2,4-D to Canopy EX to improve broadleaf burndown.

**Remarks:** Can only be applied south of I-90 west of Madison and I-94 east of Madison. Do not apply to soils with a pH less than 7.6 and do not apply any

additional Classic or Synchrony if the pH exceeds 7.0. Canopy EX is rainfast in 2 hours.

### Classic chlorimuron (2)

**Rate:** 0.5 to 0.75 oz/a if soil pH is less than 7.0 or 0.25-0.33 oz/a when tank mixed with Harmony SG.

**Adjuvants:** Add NIS at 0.25% v/v to the spray mixture. If droughty, COC at 1.0% v/v (0.5% in Classic + Harmony SG tank mixtures) can be used instead of NIS. AMS is recommended in all Classic plus -glyphosate tank mixtures. NIS at 0.25% v/v should be added when the glyphosate formulation allows for this addition.

**Crop stage:** Can be applied any time after the first trifoliate has opened but no later than 60 days before soybean maturity.

**Weed timing:** Tank mixing Classic with Flexstar, Cobra, or Ultra Blazer will control nightshade and waterhemp and improve control of common ragweed. Classic can be tank mixed with postemergence grass herbicides.

**Remarks:** Temporary yellowing and/or retardation of soybean growth may occur within 5-7 days after Classic treatment. Do not apply Classic to soybean that are under stress from weather extremes or injury from another herbicide. Use Classic spray preparations within 24 hours of mixing or product degradation may occur.

### Cobra lactofen (14)

Rate: 6.0-12.5 fl oz/a

**Adjuvants:** COC. Reduced rates of 6-10 fl oz/a, add 1 pt/a crop oil concentrate. Full rate, add crop oil concentrate at 0.25-1% to the spray mixture.

**Crop stage:** Apply at the 1-2 trifoliate leaf stage to ensure good spray coverage of weeds. Do not apply lactofen within 45 days of soybean harvest or past the R6 stage.

**Weed timing:** Apply to small, actively growing weeds. Because Cobra has contact action, weeds must be thoroughly covered. Use at least 15 gal/a of water and nozzles that produce a medium to fine droplet size. Cobra can be tank mixed with Assure II, Basagran, FirstRate, glyphosate, Raptor, Resource, or Select Max.

**Remarks:** Cobra-treated soybean almost always show some leaf burning, crinkling, and bronzing, especially on the youngest leaves. Soybean generally outgrow this condition. Injury is greatest with crop oil concentrate and increases when adding nitrogen solution or ammonium sulfate. Do not apply Cobra to soybean that are under stress from weather extremes.

### Dual II Magnum S-metolachlor (15) + safener

**Rate:** 1-2 pt/a. Rate dependent on % soil organic matter and texture, see label for details. On soils with an organic matter content between 6 and 20%, use up to 2.5 pt/a.

**Crop stage:** Apply up to 45 days preplant until 75 days before harvest. Applications made more than 30 days before planting should be part of a split application with 2/3 of the rate applied initially and the remaining 1/3 at planting. For PPI applications, incorporate into the top 2 inches of soil within 14 days before planting. Can also be applied in the fall after October 31 for spring weed control.

**Weed timing:** Provides residual control of annual grasses and small-seeded broadleaf weeds. Will not control emerged weeds. Dual II Magnum can be tank-mixed with many other PRE soybean herbicides to broaden the spectrum of control and to increase the length of residual.

**Remarks:** Can be applied as a sequential (PRE/PPI then POST) as long as no more than 3.9 pt/a (3.71 lbs/a S-metolachlor) is applied during any one crop. Do not feed forage or hay if treated POST. Dual II Magnum is formulated with the corn safener benoxacor. Dual Magnum is formulated without the benoxacor safener and has the same rate structure and product use guidelines as Dual II Magnum in soybean.

### Elevore halauxifen-methyl (4)

**Rate:** 1 fl oz/A.

**Adjuvants:** Use a Crop Oil Concentrate (COC) or Methylated Seed Oil (MSO) at 4 to 8 pints per 100 gallons (0.5 – 1.0% v/v). All adjuvants and tank-mix partners must be approved on ElevoreTankMix.com

**Crop Stage:** At least 14 days prior to planting.

**Weed timing:** Use Elevore herbicide for pre-plant burndown control of annual broadleaf weeds at least 14 days prior to planting. Elevore rapidly stops growth of established susceptible weeds. However, typical symptoms (discoloration) of dying weeds may not be noticeable for 1 or 2 weeks after application, depending upon growing conditions and weed susceptibility.

### Engenia dicamba (4)

**Burndown/PRE:** 12.8 fl oz/A in dicamba tolerant (DT) soybean. 3.2-12.8 fl oz/A in non-DT soybean.

**POST:** 12.8 fl oz/A – dicamba tolerant soybean only.

**Adjuvants:** Required for all applications: an approved drift reduction agent (DRA) PLUS an approved volatility reduction agent (VRA), like Sentris. See [www.engeniatankmix.com](http://www.engeniatankmix.com) for a current list of

approved adjuvants. Do NOT apply Engenia with ammonium containing adjuvants, conditioners, or fertilizers.

**Crop Stage:** In *DT soybean*, apply from preplant up to but prior to R1 (beginning flower) soybean OR up to and including June 30, whichever occurs first. In *non-DT soybean*, apply at least 14 days prior to soybean planting if using the 3.2-6.4 fl oz/a rate, and at least 28 days if using a rate of 6.5-12.8 fl oz/a.

**Weed Timing:** For best results apply to emerged, actively growing weeds that are 4-inches or less in height. Engenia also provides moderate residual control of some broadleaf weeds. Level of residual control is dependent on the rate used. Engenia does not provide control of emerged grasses and should be tank-mixed with an approved glyphosate or group 1 herbicide.

**Remarks:** In certain counties, a 57 ft omnidirectional in-field buffer is required to protect federally listed threatened and endangered species. You must obtain an Endangered Species Bulletin for the month you plan to apply via the EPA website, [www.epa.gov/endangered-species](http://www.epa.gov/endangered-species). Many additional stewardship practices are required to mitigate the risk for off-target movement of dicamba. Please thoroughly read the most current label for details. Only tank mix partners and nozzles approved by the EPA may be used. See [www.engeniatankmix.com](http://www.engeniatankmix.com) for a current list of approved tank mix partners and nozzles. 12.8 fl oz/A is the maximum rate that can be applied in a single application. No more than 25.6 fl oz/a (1 lb dicamba ae/a) can be applied at preplant/preemergence. No more than 25.6 fl oz/a can be applied postemergence, and no more than 51.2 fl oz/a for the season.

### Enlist Duo glyphosate (9) + 2,4-D choline (4)

**Burndown:** 3.5-4.75 pt/a

**PRE/POST:** 3.5-4.75 pt/a; Enlist soybean only.

**Adjuvants:** AMS at 1-3 lbs/a. Check [www.Enlist-TankMix.com](http://www.Enlist-TankMix.com) for all qualified AMS products.

**Crop stage:** *Enlist soybean*, apply to emerged weeds from preplant up to but no later than R1 soybean. Do not apply after the R1 growth stage. A minimum of 12 days is required between sequential POST applications *Non-Enlist soybean*, apply to emerged weeds at least 30 days prior to planting.

**Weed Timing:** Enlist Duo provides effective control of many emerged broadleaves and grasses. For best results, Enlist Duo should be applied to small (less than 4-inches tall), actively growing weeds.

**Remarks:** Do not apply more than 14.25 pt/a per season in Enlist soybean and 4.75 pt/a per season in non-Enlist soybean. Many stewardship practices are required to mitigate the risk for off-target movement of Enlist One. Thoroughly read the most current label or visit [www.Enlist.com](http://www.Enlist.com) for details.

Only tank mix partners and nozzles approved by the EPA may be used. See [www.Enlist.com](http://www.Enlist.com) for a current list of approved tank mix partners and nozzles.

### Enlist One 2,4-D choline (4)

**Burndown:** 1.5-2 pt/a in Enlist soybean. 0.5-2 pt/a in non-Enlist soybean. Rate is dependent on number of days prior to planting of non-Enlist soybean.

**PRE/POST:** 2 pt/a; Enlist soybean only.

**Adjuvants:** An adjuvant is not required when applying Enlist One alone. Use recommended adjuvants of tank-mix partners when mixing with one or more other herbicides. All adjuvants and tank-mix partners must be approved on [www.EnlistTankMix.com](http://www.EnlistTankMix.com).

**Crop Stage:** *Enlist soybean*, apply to emerged weeds from preplant up to but no later than R1 soybean. Do not apply after the R1 growth stage. A minimum of 12 days is required between sequential POST applications of Enlist One. *Non-Enlist soybean*, apply to emerged weeds at least 7 days prior to soybean planting for the 0.5-1 pt/a rate, and at least 14 days before planting if using a rate greater than 1 pt/a.

**Weed Timing:** Enlist One provides effective control of many emerged broadleaves. Enlist One should be applied to small (less than 4-inches tall) weeds. Enlist One does not provide control of emerged grasses and should be tank-mixed with glyphosate, glufosinate, or a group 1 herbicide if grasses are present.

**Remarks:** Do not apply more than 6 pt/a per season in Enlist soybean and 2 pt/a per season in non-Enlist soybean. Many stewardship practices are required to mitigate the risk of off-target movement of Enlist One. Thoroughly read the most current label or visit [www.Enlist.com](http://www.Enlist.com) for details. Only tank mix partners and nozzles approved by the EPA may be used. See [www.Enlist.com](http://www.Enlist.com) for a current list of approved tank mix partners and nozzles.

### Enlite chlorimuron (2) + flumioxazin (14) + thifensulfuron (2)

**Rate:** 2.8 oz/a

**Adjuvants:** Add 1% v/v crop oil concentrate (preferred) or 0.25% v/v nonionic surfactant.

**Crop stage:** Apply in the fall after soil temperature is less than 50°F or after October 15 or in the spring until planting. Spring applications must be made within 3 days after planting. Do not apply to cracking soybean.

**Weed timing:** Provides burndown and residual control of several broadleaf weeds. Applications in the fall should include 2,4-D or glyphosate for dandelion control. Spring burndown treatments are labeled to control 3-inch-tall weeds like mustards,

lambsquarters, pigweed, and smartweed. A tank mix with 2,4-D or glyphosate is recommended to improve control of horseweed and other broadleaf weeds. The residual control from the Valor component fits well in the spring to control lambsquarters, horseweed, nightshade, and pigweeds and to suppress other broadleaf weeds. Annual grasses and giant ragweed will also be suppressed. Burndown treatments should include glyphosate or Assure II to control grasses if present. Either fall or spring applications should be followed with a postemergence glyphosate application in Roundup Ready soybean or conventional herbicides for complete weed control.

**Remarks:** Do not tank mix with Dual, Intro, or Outlook. For further restrictions on use of other herbicides consult the label.

### Envive chlorimuron (2) + flumioxazin (14) + thifensulfuron (2)

**Rate:** 2.5 oz/a

**Adjuvants:** Add 1% v/v crop oil concentrate (preferred) or 0.25% v/v nonionic surfactant.

**Crop stage:** Apply in the fall after soil temperature is less than 50°F or after October 15 or in the spring until planting. Spring applications must be made within 3 days after planting.

**Remarks:** Can only be used south of I-90 between La Crosse and Madison and south of I-94 between Madison and Milwaukee. Contains a similar ratio of Valor to Classic as Valor XLT. The higher rate of Valor in Envive limits its use to southern Wisconsin because of potential carryover. For further restrictions on use of other herbicides consult the label.

### Extreme imazethapyr (2) + glyphosate (9)

**Rate:** 3 pt/a

**Adjuvants:** Add NIS at 0.125% plus AMS at 8.5-17 lb/100 gal.

**Crop stage:** Before planting (burndown) to POST prior to soybean flowering (R1) and 85 days before harvest. POST applications can only be made on glyphosate tolerant soybean varieties.

**Weed timing:** Provides burndown and residual control of many broadleaf and grass weeds. The pre-mix provides a combination of the broad-spectrum burndown activity of glyphosate with the residual activity of Pursuit on several broadleaf weeds. Will not provide residual control of ALS resistant weeds. Extreme may be tank mixed with Outlook or another group 15 herbicide to enhance residual grass control.

**Remarks:** Do not apply Extreme if soybean have emerged unless they are glyphosate tolerant. Make only one application of Extreme per soybean growing season. The risk of injury with Extreme is

low, but it may cause stunting.

### Fierce EZ flumioxazin (14) + pyroxasulfone (15)

**Rate:** 6-9 fl oz/a

**Adjuvants:** Use NIS at 0.25% v/v, COC or MSO at 1 % v/v if Fierce is being applied alone and weeds are present at time of application. AMS at 2-2.5 lb/a or UAN at 1-2 qt/a may also be added to enhance weed control.

**Crop stage:** Fall, preplant, PRE. Fierce herbicide can be applied preemergence in soybean but must be made within 3 days of planting. Applications after soybean plants have begun to crack, or emerge, will result in severe injury.

**Weed timing:** Provides residual control/suppression of labeled weeds. Fierce EZ also has some postemergence activity; however, weeds must be small (less than 2 inches) for adequate control. For larger weeds it is recommended to use an appropriate tank-mix partner.

**Remarks:** Fierce EZ can be used as part of a burndown program, for residual weed control and to assist in burndown of many annual and perennial broadleaf weeds. Can be tank mixed with several herbicides, including glyphosate, paraquat, dicamba, and 2,4-D, to enhance burndown activity. To improve residual weed control, Fierce can also be tank mixed with other broadleaf herbicides.

### Fierce MTZ flumioxazin (14) + pyroxasulfone (15) + metribuzin (5)

**Rate:** 1-1.5 pt/a

**Adjuvants:** Use NIS at 0.25% v/v, COC or MSO at 1 % v/v if Fierce MTZ is being applied alone and weeds are present at time of application. AMS at 2-2.5 lb/a or UAN at 1-2 qt/a may also be added to enhance weed control.

**Crop Stage:** Fall, preplant, PRE. Fierce MTZ herbicide can be applied preemergence in soybean but must be made within 3 days of planting. Applications after soybean plants have begun to crack, or emerge, will result in severe injury.

**Weed Timing:** Provides residual control/suppression of labeled weeds. Fierce also has some postemergence activity; however, weeds must be small (less than 2 inches) for adequate control. For larger weeds it is recommended to use an appropriate tank-mix partner.

**Remarks:** Fierce MTZ can be used as part of a burndown program, for residual weed control and to assist in postemergence burndown of many annual and perennial broadleaf weeds. Can be tank mixed with several herbicides, including glyphosate, paraquat, dicamba, and 2,4-D, to enhance burndown activity. Fierce MTZ may cause soybean

injury if soil conditions are cool and wet during crop establishment.

**Fierce XLT** flumioxazin (14) + pyroxasulfone (15) + chlorimuron (2)

**Rate:** 3.75 oz/a; Do not use more than 3.75 oz/a where soil pH is greater than 6.8.

**Adjuvants:** Use NIS at 0.25% v/v, COC or MSO at 1 % v/v if Fierce MTZ is being applied alone and weeds are present at time of application. AMS at 2-2.5 lb/a or UAN at 1-2 qt/a may also be added to enhance weed control.

**Crop stage:** Apply preplant until just of crop planting (PRE). Preemergence applications must be applied within 3 days of planting.

**Weed timing:** Fierce XLT will provide residual control of many grass and broadleaf weed species (see label). Can also be used as part of a preplant burndown program to assist in the burndown of many annual and perennial weeds. For control of emerged weeds, it is recommended to use an appropriate tank-mix partner.

**Remarks:** Can only be used south of I-90 between La Crosse and Madison and south of I-94 between Madison and Milwaukee. Can be applied preemergence in soybean but must be made within 3 days of planting. Applications after soybean plants have begun to crack, or emerge, will result in severe injury. Should primarily be used in no-till and minimum tillage systems. Risk of injury can be minimized by not using this product on poorly drained soils, planting seeds at least 1.5 inches deep, and applying a week or more prior to planting. Do not apply with herbicides that contain these active ingredients: flufenacet, metolachlor, alachlor, dimethenamid, or acetochlor.

**FirstRate** cloransulam (2)

**PPI/PRE Rate:** 0.6-0.75 oz/a; 0.6 oz/a if less than 3% organic matter and 0.75 oz/a if greater than 3% organic matter. In fields with moderate to heavy giant ragweed infestations up to 0.75 oz/a can be used in fields with less than 3% organic matter.

**POST Rate:** 0.3-0.6 oz/a. 0.6 oz/a can be used for especially heavy weed infestations or added residual control.

**Adjuvants:** Add NIS at 0.125-0.25% v/v AND Ammonium sulfate at 2 lb/a or UAN at 2.5% v/v. COC or MSO at 1.2% v/v are preferred over NIS in droughty conditions but may increase crop injury.

**Crop stage:** Apply preplant until prior to the R2 soybean growth stage. For preplant and preplant applications, apply within 2 weeks before planting for best results. Incorporate into the top 1-3 inches for PPI applications. Application prior to full emergence of the first soybean trifoliolate may cause temporary yellowing.

**Weed timing:** FirstRate provides both burndown and residual control of many broadleaf weeds (see label). May provide residual suppression of annual grasses at rates greater than 0.3 oz/a if adequate rainfall is received. Will not control black nightshade and will require a tank-mix partner or sequential herbicide treatment for control. Tank mixing FirstRate with group 15 herbicides such as Dual II Magnum, Outlook, or Zidua will provide both grass and black nightshade control.

**Remarks:** Labeled tank-mix partners include most postemergence broadleaf and grass herbicides. May antagonize group 1 grass herbicides, so sequential applications are recommended. Soybean stunting seems to be minimal and temporary.

**Flexstar** fomesafen (14)

**Rate:** 1.0-1.3 pt/a; The maximum rate is 1.3 pt/a south of Highway 18 west of Madison and south of I-94 east of Madison. Maximum use rate is 1 pt/a in regions south of interstate 94 from Minnesota to Eau Claire and south of highway 29 from Eau Claire to Green Bay plus Barron, Burnett Chippewa, Clark, Door, Dunn, Eau Claire, Kewaunee, Langlade, Lincoln, Marathon, Marinette, Menominee, Oconto, Polk, Price, Rusk, Shawano, St. Croix, Taylor and Washburn counties Flexstar is not registered for use in Adams, Marquette, Portage, Waupaca, Waushara, and Wood counties or in far northern Wisconsin counties.

**Adjuvants:** Add NIS at 0.25-0.5% v/v or COC or MSO at 0.5-1% v/v PLUS 28-32% UAN at 1-2.5% v/v or AMS at a minimum of 8.5 lb/100 gal. MSO is the preferred adjuvant for effectiveness on weeds but can cause more soybean leaf burn.

**Crop stage:** Apply before soybean bloom.

**Weed timing:** The maximum leaf stage is 2-6 leaves depending on broadleaf species and rate. See label for specific weeds. Will not provide adequate control of common lambsquarters. Can be tank mixed with all POST grass herbicides, but it may reduce the activity of the herbicide. Flexstar also provides residual control of many broadleaf weeds. **Remarks:** Soybean treated with Flexstar POST almost always show some leaf speckling, crinkling, and bronzing, especially on the youngest leaves, generally outgrowing this condition without reduced crop vigor. Because Flexstar has contact action, weeds must be thoroughly covered with spray. Use 15-20 gal/a of water and 30-60 psi pressure through flat fan or hollow cone nozzles. Flexstar can only be used in alternate years.

**Flexstar GT 3.5** fomesafen (14) + glyphosate (9)

**Rate:** 3-3.75 pt/a; The maximum rate is 3.75 pt/a

south of Highway 18 west of Madison and south of I-94 east of Madison. Maximum use rate is 3 pt/a in regions south of interstate 94 from Minnesota to Eau Claire and south of highway 29 from Eau Claire to Green Bay plus Barron, Burnett Chippewa, Clark, Door, Dunn, Eau Claire, Kewaunee, Langlade, Lincoln, Marathon, Marinette, Menominee, Oconto, Polk, Price, Rusk, Shawano, St. Croix, Taylor and Washburn counties Flexstar GT is not registered for use in Adams, Marquette, Portage, Waupaca, Waushara, and Wood counties or in far northern Wisconsin counties.

**Adjuvants:** Add AMS at 8.5-17.0 lb/100 gal of spray mixture. Flexstar GT 3.5 contains an adjuvant, but MSO, COC, or NIS can be added in adverse conditions.

**Crop stage:** Apply up to 45 days before harvest.

**Weed timing:** At 3.5 pt/a, common broadleaf weeds are labeled for control up to 4 inches tall, and most annual grasses are labeled for control up to 12 inches tall.

**Remarks:** Use only on glyphosate tolerant soybean varieties. Flexstar GT 3.5 can be tank mixed with postemergence grass herbicides to control glyphosate-resistant corn. This premixture of Flexstar with glyphosate will control glyphosate-resistant weeds, but they will need to be sprayed at a smaller size in order for them to be controlled by the Flexstar component. The adjuvant in Flexstar GT 3.5 is designed to reduce speckling and crinkling of soybean leaves, but some symptoms should still be expected. The soybean should outgrow these symptoms within several days. Because the Flexstar component has contact activity, weeds need thorough spray coverage. Use 15-20 gal/a of water and 30-60 psi pressure with flat fan nozzles. Do not apply if wind exceeds 15 mph. Flexstar GT 3.5 can only be used in alternate years.

**Fusilade DX** fluazifop (1)

**Rate:** 4-6 fl oz/a

**Adjuvants:** Add 0.25% v/v COC.

**Crop stage:** Apply from emergence until soybean bloom.

**Timing:** Apply before volunteer Roundup Ready corn is 12 inches tall.

**Remarks:** Fusilade DX has a supplemental label recommending a tank mixture with glyphosate to control volunteer Roundup Ready corn in Roundup Ready soybean. With favorable soil moisture and weather conditions, the 4 fl oz/a rate can be used. Fusilade DX can be used for annual grass control in conventional soybean, but other postemergence grass herbicides are recommended.

## Fusion fluazifop (1) + fenoxaprop (1)

**Rate:** 8 fl oz/a; Fusion can be tank mixed with glyphosate to control volunteer Roundup Ready corn. Use 4 fl oz/a of Fusion if the corn is less than 12 inches tall and the 6 fl oz rate if the corn is 12-24 inches tall.

**Adjuvants:** COC, NIS, N, AMS. Add crop oil concentrate at 0.5-1% or nonionic surfactant at 0.25-0.5% to the spray mixture. Use crop oil concentrate at 1% when treating perennial grasses.

**Crop stage:** Apply before bloom.

**Remarks:** Fusion can be tank mixed with most broadleaf herbicides, but antagonism may reduce grass control. To compensate, the Fusion rate can be increased 4 fl oz/a in tank mixtures. When yellow foxtail, barnyardgrass, woolly cupgrass, sandbur, or crabgrass are a problem, apply Fusion sequentially to postemergence broadleaf herbicides. In sequential applications, apply Fusion 2 or 3 days before or 7 days after the broadleaf herbicide application. Do not apply Fusion to grasses that are stressed from weather extremes or injury from another herbicide.

## glufosinate glufosinate (10)

\*There are several brands of glufosinate (Liberty, Cheetah, Interline) available for use. Application rates, adjuvant recommendations, rainfast intervals, and other guidelines for use may vary among glufosinate products. Consult product labels for more specific product use guidelines and restrictions.

**Rate:** 0.53-0.79 lb ai/a; 29-43 fl oz/a of 2.34 lb/gal formulation. A minimum of 32 fl oz/a is recommended in the Liberty label.

**Adjuvants:** AMS at 1.5-3 lbs/a. Higher rates are recommended under unfavorable growing conditions. An anti-foam agent is recommended.

**Crop stage:** Can be applied as part of a preplant burndown program prior to planting of any soybean variety. Can be applied postemergence in glufosinate tolerant soybean varieties (LibertyLink, LLGT27, Enlist, XtendFlex) from emergence up to soybean flowering (R1) OR 70 days before harvest, whichever occurs first.

**Weed timing:** Apply to small (<3 inches) and actively growing weeds. Glufosinate is only foliar active and does not provide any residual control. Glufosinate can be tank mixed with a group 15 herbicide to provide residual control of certain grasses and small-seeded broadleaves.

**Remarks:** For best results, make applications in warm temperatures, high humidity, and bright sunlight. Use nozzles that deliver medium-sized droplets for adequate spray coverage with a minimum of 15 gal/a spray solution. Increase rate to between 20 and 40 gal/a for dense canopy, large weeds, or unfavorable growing conditions. Sequential POST

applications can be made in glufosinate tolerant soybeans but do not exceed 0.79 lb ai/a per year (87 fl oz/a). The second application should be made a minimum of 5 days after the first. Glufosinate tolerant varieties have good tolerance to glufosinate, but slight speckling of leaves may occur.

## glyphosate glyphosate (9)

\*There are many brands of glyphosate available for use. Application rates, adjuvant recommendations, rainfast intervals, and other guidelines for use may vary among glyphosate products. Consult product labels for more specific product use guidelines and restrictions.

**Rate:** 0.56-1.5 lb acid equivalent/a (lb ae/a). The general recommendation on most labels is 0.75 lb ae/a (22 fl oz/a Roundup PowerMax). Rate should be increased to 1.1-1.5 lb ae/a (32-44 fl oz Roundup PowerMax) for perennials, larger weeds or in fields with a history of poor glyphosate performance.

**Adjuvants:** AMS at 8.5-17 lb/100 gal is typically recommended. Adjuvant recommendations vary among different glyphosate products. Consult specific product labels to see if the glyphosate formulation requires additional surfactant.

**Crop stage:** *Any soybean* - preplant burndown. *Glufosinate tolerant soybean only* - apply from soybean emergence through full flowering (R2) Soybean exceeds the R2 growth stage when a single pod is at least 3/16-inch-long at one of the four uppermost nodes on the main stem

**Weed timing:** Glyphosate is a non-selective herbicide that controls most emerged annual and perennial grass and broadleaf weeds. *Annuals* - Best results are achieved when applied to weeds less than 4-8 inches tall. Annual weeds emerging after glyphosate application must be controlled by a residual herbicide or a postemergence herbicide.

Glufosinate resistance has developed in populations of waterhemp, giant ragweed, and marestail in Wisconsin. Consider the use of an effective PRE herbicide and apply glyphosate at 1.5 lb ae/a when plants are small. *Perennials* - Best control of perennials will occur at higher labeled rates when applied at the bud-bloom weed stage (or boot to seedhead for grasses). Minimum size of various perennial weeds for most effective control: quackgrass, Canada thistle, and yellow nutsedge - 6 inches; field bindweed and common milkweed - 12 inches; johnsongrass and hemp dogbane - 18 inches. To control quackgrass, apply 0.75 lb ae/a of glyphosate to 6-10-inch quackgrass if the field will be tilled after application. Delay tillage for 3 days after application. Increase the rate of glyphosate to 1.5 lb ae/a if the field will be no-till planted. Glyphosate can be tank mixed with 2,4-D ester for improved annual and perennial broadleaf weed burndown, but must

be applied at least 7 days before planting.

**Remarks:** Apply POST only on glyphosate tolerant soybean varieties. Glyphosate can be tank mixed with Assure II, Fusilade DX, Fusion, or clethodim to control volunteer Roundup Ready corn. In glyphosate tolerant soybean varieties, do not exceed 6 lb ae/a per year; 3.7 lb ae/a for all preplant, at-planting, or preemergence applications; and 2.25 lb ae/a for all in crop applications.

## Gramoxone SL 3.0 paraquat (22)

**Rate:** 1.3-2.7 pt/a. Apply 1.3-2.0 pt/a when weeds are 1-3 inches tall and 2.0-2.7 pt/a when weeds are 3-6 inches tall.

**Adjuvants:** Add NIS at 0.25% v/v. An appropriate COC or MSO adjuvant can be used at 1% v/v in place of NIS; however, NIS is the preferred adjuvant system when tank-mixed with other herbicides.

**Crop stage:** Apply preplant or before soybean has emerged.

**Weed timing:** Will only control emerged weeds.

Can include with preplant residual herbicides to provide residual control. Where a preplant treatment is made as a split application, include Gramoxone with the first application, but only if weed growth is present at the time of treatment. Annual weeds emerging after application must be controlled by the residual herbicide. Tank mixing Metribuzin or LoroX with Gramoxone usually increases burndown activity.

**Remarks:** Use a minimum of 10 gal/a of water at 30-50 psi pressure with ground applications. Flat fan nozzles are more effective than flood nozzles at delivering the fine spray droplets necessary for thorough spray coverage. If applying less than 20 gal/a of water, only use flat fan nozzles. Do not apply Gramoxone when conditions prevent uniform coverage or when excessive spray drift may occur.

## Harmony SG thifensulfuron (22)

**Rate:** 0.125 oz/a; Alone or with glyphosate on Roundup Ready soybean.

**Adjuvants:** Add NIS at 0.125-0.25% v/v or COC at 0.5% v/v to the spray mixture. Also include 2-4 qt/a of 28% nitrogen solution or 1-2 qt/a of 10-34-0 in the spray mixture. Ammonium sulfate at 2-4 lb/a may also be used.

**Crop stage:** Apply after the first trifoliate leaf (V1), but 60 days before harvest.

**Remarks:** Harmony can be tank mixed with postemergence grass herbicides, Basagran, Classic, Flexstar, or lactofen. Harmony can be tank mixed with glyphosate to increase lambsquarters control in glyphosate tolerant soybean. Temporary yellowing and/or reduction of soybean growth may occur within 5-7 days after Harmony treatment. Such

injury occurs most frequently during hot, humid weather. Do not apply Harmony to soybean that are under stress from weather extremes or injury from another herbicide. Do not tank mix Harmony with organophosphate insecticides or apply Harmony within 14 days before or after such insecticide use.

**Kyber** flumioxazin (14) + pyroxasulfone (15) + metribuzin (5)

See information under Fierce MTZ.

**Liberty 280 SL** glufosinate (10)

**Rate:** 32-43 fl oz/a

**Adjuvants:** AMS at 1.5-3 lbs/a. Higher rates are recommended under unfavorable growing conditions. An anti-foam agent is recommended. The Liberty 280 SL formulation contains built in surfactants.

For additional use guidelines see information under glufosinate.

**Lorox** linuron (7)

**Rate:** 1-2 lb/a; Lower rates of Lorox can be tank mixed with group 15 herbicides such as, Dual II Magnum, Outlook, or Zidua to improve grass control.

**Crop stage:** Apply after planting but before soybean emerge.

**Remarks:** Lorox is ineffective on peat or muck soils. Risk of soybean injury increases markedly on sandy soils. Do not use Lorox on sand, loamy sand, or any soil with less than 1% organic matter. Plant soybean at least 1.75 inches deep. Even on medium and heavy soils, heavy rainfall following application can leach Lorox to the soybean root zone causing foliar burn and stand reduction. Applications to areas with residual atrazine may cause serious soybean injury.

**Marvel** fluthiacet-methyl (14) + fomesafen (14)

**Rate:** 5.0-7.25 fl oz; Marvel is NOT labeled for use north of I-94 from the Minnesota state line to Eau Claire and north of Highway 29 from Eau Claire to Green Bay. It can also NOT be used south of that line in Barron, Chippewa, Clark, Door, Dunn, Eau Claire, Kewaunee, Marathon, Menominee, Oconto, Polk, Shawano, and St. Croix counties. See label for annual and biannual rate limits, as they change based on location in Region 3 (southern tier counties) or Region 4 (all other counties not in Region 3 or where use is restricted).

**Adjuvants:** Add NIS at 0.25-0.5% v/v or COC or MSO at 0.5-1% v/v PLUS UAN at 1-2 qt/a or spray grade AMS at 2-3 lb/a.

**Crop stage:** Prior to planting soybean up through

the flowering stages of soybean (up to R3).

**Weed timing:** Controls many small broadleaf weeds; however, it is a contact herbicide and thorough spray coverage is important for weed control and many weeds greater than 3-4 inches tall will be difficult to control. To improve burndown activity, it can be tank mixed with other burndown herbicides such as glyphosate, glufosinate, paraquat, or 2,4-D. Will also provide some early-season residual control of small seeded broadleaves. However, when tank mixed with other burndown herbicides follow preplant restrictions of tank-mix partners. Can also be applied postemergence through the flowering stages of soybean (up to R3). Spray when target broadleaf weeds are less than 3-4 inches tall and mix with other postemergence herbicides like glyphosate (in Roundup Ready varieties) or glufosinate (in Liberty Link varieties).

**metribuzin 75DF/metribuzin 4L** metribuzin (5)

\*There are many brands of metribuzin available for use. Most metribuzin products are formulated as either a dry granular containing 75% active ingredient ai (Tricor DF, Glory, Dimetric, etc.) or a liquid containing 4 lb ai/gal (Tricor 4F, Glory 4L, Mauler, etc.). See individual product labels for specific product use guidelines and restrictions.\*

**Burndown Rate:** *metribuzin 75DF:* 2-5.33 oz/a, *metribuzin 4L:* 3-8 fl oz/a

**PPI/PRE Rate:** *metribuzin 75DF:* 0.33-1.17 lb/a. *metribuzin 4L:* 0.5-1.75 pt/a Rate is dependent on % organic matter and soil texture, see label for details. Rates can also be adjusted depending on tank-mix partner, see label for details.

**Adjuvants:** The use of an adjuvant is only necessary in burndown applications with certain tank-mix partners. Consult the labels of all products in the tank-mix for adjuvant recommendations.

**Crop stage:** Apply before planting or within 3 days after planting. For PPI applications incorporate into the upper 1-2" of soil. Do not apply if soybean seedlings are emerging.

**Weed timing:** Provides residual control/suppression of many annual broadleaves and grasses. Length of residual control will depend on the rate used. Metribuzin can be tank mixed with many other PRE soybean herbicides to broaden the spectrum of control and to increase the length of residual. Metribuzin will also provide enhanced burndown control of several broadleaf weed

**Remarks:** Metribuzin is ineffective on peat or muck soils. Risk of soybean injury increases on lighter-textured soils and on soils with a pH of 7.5 or higher. Do not use metribuzin on sand regardless of organic matter content, on loamy sand or sandy loam with less than 1% organic matter, or on any

soil with less than 0.5% organic matter. Plant soybean 1.5 inches deep. Heavy rainfall following application can leach metribuzin to the soybean root zone causing foliar burn and stand reduction. Applications to areas with residual atrazine may cause serious soybean injury.

**Outlook** dimethenamid-P (15)

**Rate:** 8-21 fl oz/a; Rate dependent on % soil organic matter and texture, see label for details. Reduced rates of 8-16 fl oz/a may be used in conjunction with a planned follow up application of glufosinate, glyphosate, dicamba, or 2,4-d on the appropriate GMO soybean variety or in POST applications of Outlook.

**Crop stage:** Apply up to 45 days preplant through the V5 soybean growth stage. Applications made more than 30 days before planting should be part of a split application with 2/3 of the rate applied initially and the remaining 1/3 at planting. For PPI applications, incorporate into the top 2 inches of soil within 14 days before planting. Can also be applied in the fall after October 1 for spring weed control.

**Weed timing:** Provides residual control of annual grasses and small-seeded broadleaf weeds. Will not control emerged weeds. Outlook can be tank-mixed with many other PRE soybean herbicides to broaden the spectrum of control and to increase the length of residual.

**Remarks:** A maximum of 24 fl oz/a per year can be used in two split applications of 8-16 fl oz each at least 14 days apart. Outlook generally does not injure soybean, but long periods of saturated soil may suppress early season soybean growth. Temporary soybean leaf burn and/or stunting may occur with POST applications of Outlook. Certain tank mixtures with other herbicides and/or adjuvants may increase crop injury, but injury does not typically reduce soybean yield.

**Panther PRO** imazethapyr (2) + metribuzin (5) + flumioxazin (14)

**Rate:** 12-15 fl oz/a. Rate is dependent on soil type and weed species, see label for specific rate information.

**Adjuvants:** NIS at 0.25% v/v or COC, MSO at 1-2 pts/a plus AMS at 2-2.5 lbs/a or UAN at 1-2 qts/a.

**Crop Stage:** Fall, preplant, PRE (within 3 days of planting).

**Weed Timing:** Panther PRO provides residual control/suppression of broadleaf weeds and grass weeds. Panther PRO also provides burndown activity on labeled weeds.

**Remarks:** Panther PRO can be used as part of a burndown program, for residual weed control and to assist in postemergence burndown of many annual

and perennial broadleaf weeds. Can be tank mixed with several herbicides, including glyphosate, glufosinate, paraquat, and 2,4-D, to enhance burndown activity. Do not till the soil following an application of Panther PRO or residual control will be reduced. Do not apply to sand, sandy loam, or loamy sand soils containing less than 2% organic matter. Do not apply to soils with a pH of 7.5 or higher. Do not tank mix with metolachlor, dimethenamid, flufenacet, or alachlor products within 14 days of planting soybeans as severe injury to soybeans may occur. In the fall, do not apply to frozen or snow-covered ground.

### Phoenix lactofen (14)

**Rate:** 6.0-12.5 fl oz/a

**Adjuvants:** Phoenix contains a premixed adjuvant. Add NIS at 0.125-0.25% v/v. Use the high concentration when weeds are at their maximum labeled size. COC can be used at 1 pt/a if droughty.

**Crop stage:** Apply at the 1-2 trifoliate leaf stage to ensure good spray coverage of weeds. Do not apply lactofen within 45 days of soybean harvest or past the R6 stage.

**Remarks:** Can be tank mixed with Assure II, Basagran, FirstRate, glyphosate, Raptor, Resource, or Select Max. Phoenix-treated soybean almost always show some leaf burning, crinkling, and bronzing, especially on the youngest leaves. Soybean generally outgrow this condition. Injury is greatest with crop oil concentrate and increases when adding nitrogen solution or ammonium sulfate. Do not apply Phoenix to soybean that are under stress from weather extremes. Because Phoenix has contact action, weeds must be thoroughly covered. Use 20-30 gal/a of water with Phoenix Apply at 40-60 psi pressure through flat fan or hollow cone nozzles spaced 20 inches apart.

### Poast Plus sethoxydim (1)

**Rate:** 1.5 pt/a

**Adjuvants:** COC, N, AMS. Add 1 qt/a of crop oil concentrate. When controlling volunteer corn or crabgrass, include 2-4 qt/a 28% nitrogen solution or 2.5 lb/a ammonium sulfate with crop oil concentrate.

**Crop stage:** Apply any time, but 75 days before harvest.

**Remarks:** Poast Plus can be tank mixed with most postemergence broadleaf herbicides, but grass control may be reduced. This antagonism can be avoided by applying Poast Plus 1 day before or 7 days after the broadleaf herbicide. Soybean injury is not a problem. Do not apply Poast Plus to grasses that are stressed from weather extremes or injury from another herbicide. Do not apply if wind exceeds 10 mph.

### Prefix S-metolachlor (15) + fomesafen (14)

**PP/PPI/PRE Rate:** 2.0-2.5 pt/a; 2 pt/a is commonly recommended as part of a foundation treatment for planned two-pass weed control program.

Maximum use rate is 2.5 pt/a in regions south of highway 18 between Prairie Du Chien and Madison and interstate 94 between Madison and Milwaukee. Maximum use rate is 2 pt/a in regions south of interstate 94 from Minnesota to Eau Claire and south of highway 29 from Eau Claire to Green Bay plus Barron, Burnett Chippewa, Clark, Door, Dunn, Eau Claire, Kewaunee, Langlade, Lincoln, Marathon, Marinette, Menominee, Oconto, Polk, Price, Rusk, Shawano, St. Croix, Taylor and Washburn counties. Prefix is not registered for use in Adams, Marquette, Portage, Waupaca, Waushara, and Wood counties or in northern Wisconsin.

**POST Rate:** 2-2.33 pt/a. Regional max use rate restrictions still apply, see above.

**Adjuvants:** Add NIS at 0.25% v/v if Prefix is being used to control emerged weeds, unless mixing with a herbicide product that contains a built in surfactant. The use of COC or MSO is not advised due to increased risk of crop injury

**Crop stage:** Apply anytime before planting (PP/PPI/PRE) up to the V3 soybean growth stage or 75 days before harvest (POST). For PPI applications, incorporate into the top 2 inches of soil within 7 days after application.

**Weed timing:** Prefix will provide residual control/suppression of many annual grasses and broadleaves. The length and degree of residual control will depend on the soil texture and organic matter. The fomesafen (Flexstar) component of Prefix also provides control of some emerged broadleaves. For best POST control, include the appropriate adjuvant and apply to small, actively growing weeds. Prefix can be tank mixed with other labeled POST soybean herbicides to broaden the spectrum of control.

**Remarks:** If the maximum rate of Prefix was soil-applied, do not apply Flexstar postemergence. When applying other S-metolachlor containing products in the same field, do not exceed 2.48 lb ai/a per year of S-metolachlor. Necrotic spotting, bronzing, crinkling, or curling of soybean leaves may occur following POST applications of Prefix. application.

### Preview 2.15C sulfentrazone (14) + metribuzin (5)

**Rate:** 11-26 fl oz/a; Rate dependent on % organic matter and soil texture. See label for details.

**Adjuvants:** Add NIS at 0.25% v/v or COC at 1 qt/a in burndown applications to enhance control of emerged weeds.

**Crop stage:** Apply from 45 days before planting up

to 3 days after planting. For PPI applications, do not incorporate deeper than 2 inches into the soil. Do not apply if soybean seedlings are emerging.

**Weed Timing:** Provides residual control/suppression of many broadleaf weeds and suppression of some grass species. Preview 2.15C can be tank mixed with other preemergence grass herbicides to improve grass control. The length of residual activity will depend on the rate used. Preview 2.15C can provide for increased burndown activity of some broadleaf weeds up to 3" tall in no-till applications. However, it is not intended to replace an appropriate preplant burndown program.

**Remarks:** Do not apply to sands with less than 1% organic matter. Heavy rains after application, cold, wet soils, or soils with a pH greater than 7.5 may increase the risk of injury. To reduce the risk of injury, use a maximum of 11 fl oz/a on soil with pH greater than 7.5. The seed furrow must be closed prior to application or crop injury may result.

### Prowl H2O pendimethalin (3)

**Rate:** 1.5-3.0 pt/a

**Crop stage:** Apply to dry soil within the several weeks before planting. Incorporate into the top 1-2 inches of soil within 7 days of application.

**Remarks:** To broaden the spectrum of weed control, it can be tank mixed with Command, Dual II Magnum, metribuzin, or Pursuit. Pendimethalin is ineffective on peat or muck soils. Soybean injury doesn't appear to be a problem except when applied to wet soils or in areas subject to prolonged flooding. Injury symptoms are stunted soybean plants with swollen stems and inhibited secondary roots. Pendimethalin can be impregnated onto certain dry fertilizers for simultaneous application.

### Pursuit imazethapyr (2)

**Rate:** 4 fl oz/a

**Adjuvants:** Add NIS at 0.25% v/v or COC at 1% v/v. Also include 1.25-2.5% v/v of either 28-0-0, 32-0-0, or 10-34-0 fertilizer. Ammonium sulfate at 12-15 lbs/100 gal may be substituted for liquid fertilizer.

**Crop stage:** Apply up to 45 days before planting (PP/PPI/PRE) to prior to soybean flowering (POST) and 85 days before harvest For PPI applications, apply to dry soil and blend into the top 1-2 inches of soil.

**Weed timing:** Pursuit provides both burndown and residual control of many broadleaf and grass weeds. Apply before weeds are 3 inches tall for best results in burndown applications. Pursuit can be tank-mixed with many other PRE and POST soybean herbicides to broaden the spectrum of weed control (see label for specific recommendations). The

effectiveness of a group 1 grass herbicide may be reduced due to antagonism from Pursuit

**Remarks:** Do not apply Pursuit more than once per season or the same year as other imazetha-pyr-containing herbicides. Do not tank mix with Command. Pursuit is ineffective on peat or muck soils. Risk of soybean injury from Pursuit is minimal but it occasionally causes internode shortening and a reduction in fine root hairs.

### Python WDG flumetsulam (2)

**Rate:** 0.8-1.33 oz/a. Coarse soil – 0.8-0.89 oz/a; medium/fine soil – 0.89-1 oz/a. Within a soil texture class, use the higher rate in the rate range on soils with >3% organic matter.

**Adjuvants:** Add NIS at 0.25% v/v when making applications to emerged weeds. 28-32% UAN at 2.5% v/v may enhance control under dry growing conditions. COC at 1% v/v can be used instead of NIS in preplant burndown applications.

**Crop stage:** Apply before planting (PP/PPI) until prior to soybean cracking (PRE) Apply POST from the V1 to V5 growth stage. For PPI applications, incorporate into top 2-3 inches of soil within 30 days before planting.

**Weed timing:** Provides residual and burndown control of labeled broadleaf weeds. At lower labeled rates Python controls lambsquarters, pigweed, and velvetleaf. Higher labeled rates control smartweed and nightshade. Some common and giant ragweed will escape control, even at higher rates. Will not control ALS resistant weeds.

**Remarks:** Do not use on peat or muck soils. Soybean have shown good tolerance to Python when applied PRE. Temporary chlorosis and/or stunting may be evident for 5-7 days after POST applications.

### Raptor imazamox (2)

**Rate:** 4-5 oz/a; Apply 4 fl oz/a when following a preemergence grass herbicide or 5 fl oz/a when all herbicide applications are postemergence.

**Adjuvants:** Add nonionic surfactant at 0.25% to the spray mixture, 1% crop oil concentrate, or 1% methylated seed oil. Also include 1-2 qt/a of either 28-0-0 or 10-34-0 fertilizer solution. Ammonium sulfate at 2.5 lb/a may be substituted for liquid fertilizer.

**Crop stage:** Apply before bloom and 85 days before harvest.

**Remarks:** Common ragweed may require a tank mix for complete control. Without a prior preemergence grass herbicide treatment, Raptor may not adequately control barnyardgrass, crabgrass, wild proso millet, or woolly cupgrass. If Raptor is tank mixed with a post-emergence grass herbicide, grass weed control may be reduced. This antagonism

can be avoided by applying the grass herbicide 3 days before or 7 days after the application of Raptor. Raptor may be tank mixed with FirstRate to increase control of common and giant ragweed. Cobra, Flexstar, or Ultra Blazer tank mixtures may increase control of waterhemp and ragweed. Tank mixing broadleaf herbicides with Raptor may also reduce its grass control. Raptor may be tank mixed with Outlook for residual grass control. There is a risk that Raptor may cause temporary chlorosis and shortening of internodes.

### Resource flumiclorac (14)

**Rate:** 4-12 fl oz/a

**Adjuvants:** Add 1 qt/a crop oil concentrate when applying Resource alone. Check the Resource label for adjuvant requirements when tank mixing.

**Crop stage:** Do not apply within 60 days of harvest.

**Remarks:** Resource is highly effective on velvetleaf. It is less effective on other broadleaf weeds but will suppress small lambsquarters, cocklebur, common ragweed, and pigweed. Resource can be tank mixed at 2-4 fl oz/a with postemergence broadleaf herbicides or glyphosate for added velvetleaf control. Resource may cause temporary speckling of soybean leaves, but plants quickly outgrow this injury.

### Roundup PowerMAX glyphosate (9)

**Rate:** Roundup PowerMAX II/Roundup Weather-MAX – 22-44 fl oz/a; Roundup PowerMAX 3 – 20-40 fl oz/a

**Adjuvants:** AMS at 8.5-17 lb/100 gal is typically recommended. Roundup brands contain a built in adjuvant system so additional adjuvants are not required. For additional use guidelines see information under glyphosate.

### Select Max clethodim (1)

**Rate:** 9-16 fl oz/a; Use 16 fl oz/a when annual grasses are at the maximum height listed for control.

**Adjuvants:** Add NIS at 0.25% v/v or COC at 1 qt/a to the spray mixture AND ammonium sulfate at 2.5 lb/a or 2 qt/a 28% nitrogen solution.

**Crop stage:** Apply 60 days before harvest.

**Remarks:** Select Max at 6 fl oz/a can be tank mixed with glyphosate to control Roundup Ready corn up to 12 inches tall. Higher rates can be used to control taller corn. Select Max can be tank mixed with broadleaf herbicides, but grass control may be reduced. Increased rates should be used with Pursuit and Raptor tank mixtures. This antagonism can be avoided by applying Select Max 1 day before or 7 days after the broadleaf herbicide. When tank mixing, check the label for specific adjuvant options

for the mixture. If regrowth of perennial grasses occurs, make a second application of Select Max. Do not apply if wind is greater than 10 mph.

### Sequence glyphosate (9) + S-metolachlor (15)

**Rate:** 2.5-4.5 pt/a; Rate is based on soil texture, soil organic matter, and weed height.

**Adjuvants:** Ammonium sulfate may be added at 8.5-17.0 lb/100 gal.

**Crop stage:** Apply preplant or preemergence up to 75 days before harvest. Applications to emerged soybeans can only be made to glyphosate tolerant soybean varieties.

**Weed timing:** Will provide similar levels of control of emerged weeds to that of glyphosate. The s-metolachlor component will provide residual control of annual grass weeds and certain small seeded broadleaves. The label has specific rates for individual weed heights.

**Remarks:** Sequence at 2.5 pt/a provides 0.7 lb ae/a glyphosate and should be effective on most annual weeds if treated before the 6-inch height. Contains the equivalent of 1.0-1.8 pt/a of Dual II Magnum over the labeled rate range. Can be tank mixed with Fusion or Fusilade DX to control volunteer Roundup Ready corn or Classic, FirstRate, or Flexstar for added broadleaf control. Sequence may cause some slight leaf crinkle or leaf spotting, but the soybean should rapidly outgrow this symptom.

### Sharpen saflufenacil (14)

**Rate:** 1-2 fl oz/a; Applying 1 oz/a requires 30 days preplant interval on course soils with 2% organic matter and 0 days on other soils. 1.5 oz/a requires 30 days preplant interval on course soils with 2% organic matter and 14 days preplant on other soils. 2 oz/a requires 44 days preplant interval on course soils with 6 2% organic matter and 30 days preplant on other soils.

**Adjuvants:** Add MSO at 1% v/v plus AMS at 8.5-17 lb/100 gal or UAN at 1.25-2.5% v/v in burndown situations.

**Crop stage:** Apply before planting up to 3 days after planting. Application timing will depend on rate used and soil properties. Severe crop injury will occur if applied after crop emergence.

**Weed timing:** Sharpen can aid in the burndown of emerged broadleaf weeds prior to planting, especially marestail. Sharpen can be tank mixed with Gramoxone, glyphosate, or glufosinate to increase burndown activity and to control emerged grasses. It also provides low level residual control of many broadleaves at the 1 oz/a rate and residual control improves as the rate is increased. Sharpen should be tank mixed with other PRE residual herbicides for broad-spectrum weed control, particularly grasses,

see label for restrictions for tank mixes with other group 14 herbicides.

**Remarks:** Sharpen has good crop tolerance but may cause injury under stressful growing conditions. Do not use on sands with less than 3% organic matter and where depth to ground water is 30 feet or less. Sharpen may also be used as a harvest aid. See label for details.

### **Sonic** sulfentrazone (14) + cloransulam (2)

**Rate:** 6.45-8 oz/a; Rate dependent on % organic matter. See label for details. Reduced rates of 3-6 oz/a can be used in conjunction with a planned follow up application of glufosinate, glyphosate, dicamba, or 2,4-d on the appropriate GMO soybean variety. Reduced rates are not advisable when managing herbicide resistant or tough to control weeds like waterhemp.

**Adjuvants:** Add NIS at 0.25% v/v plus AMS at 2.5% v/v in burndown applications. COC or MSO at 1.2% v/v may also be used instead of NIS.

**Crop stage:** Apply before planting or within 3 days after planting. For PPI applications, incorporate into the upper 1-3" of soil within 14 days of planting. Do not apply if soybean seedlings are emerging.

**Weed timing:** Provides residual control/suppression of many broadleaf and grass weeds. The length of residual activity will depend on the rate used. At full rates, annual grasses will be suppressed, but will likely need to be controlled postemergence. Can be tank mixed with other preemergence grass herbicides to improve grass control. At the full rate, Sonic can provide for increased burndown activity of some broadleaf weeds up to 3" tall in no-till applications. However, it is not intended to replace an appropriate preplant burndown program.

**Remarks:** Do not apply to sands with less than 1% organic matter. The seed furrow must be closed prior to applying this premix or crop injury may result.

### **Spartan 4F** sulfentrazone (14)

**Rate:** 4.5-12 fl oz/a. Rates are based on soil texture and % organic matter, see label for specific rate information.

**Adjuvants:** An MSO or COC at 1% v/v can be used to enhance the burndown activity of Spartan.

**Crop Stage:** Fall, preplant, PRE (within 3 days of planting).

**Weed timing:** Provides residual control/suppression of labeled weeds. Spartan also has some postemergence activity; however, weeds must be small (less than 2 inches) for adequate control. For larger weeds and to increase the spectrum of control, it is recommended to use an appropriate tank-mix partner.

**Remarks:** Spartan (sulfentrazone) is a component

of many soybean herbicide premixes including all the Authority® brands. It is recommended to utilize a residual herbicide with a different mode of action, like group 15, to increase the spectrum of weed control and for resistance management. Spartan can be used as part of a burndown program, for residual weed control and to assist in postemergence burndown of many annual and perennial broadleaf weeds. Do not apply more than 12 fl oz/a per twelve-month period. Fall applications can be made when soil temperatures at the 4-inch depth are sustained at less than 55°F and before the ground freezes. Apply after September 30 in areas N of I-90 and after October 15 in areas N of I-70. For preplant incorporated (PPI) applications, incorporate into the upper 1-2 inches of soil before planting.

### **Surveil** cloransulam (2) + flumioxazin (14)

**Rate:** 3.5-4.2 oz/a. Use higher rates for difficult to control weeds such as giant ragweed

**Adjuvants:** Include COC or MSO at 1-2 pt/a if applying to emerged weeds as part of a preplant burndown program.

**Crop Stage:** Apply preplant in the Fall or Spring to 3 days after planting. Do not apply if soybeans have begun to crack as severe injury will occur.

**Weed timing:** Surveil will provide residual control of many grass and broadleaf weed species (see label). Can also be used as part of a preplant burndown program to assist in the burndown of many annual and perennial weeds. For control of emerged weeds, it is recommended to use an appropriate tank-mix partner.

**Remarks:** A premix product that is a mix of Valor and FirstRate, with similar performance except a reduced rotational interval to 10 months for alfalfa. Do not tank mix Surveil with group 15 herbicides, such as Warrant, Dual II Magnum, Outlook or Zidua if applied within 14 days of planting soybeans, unless planted into reduced tillage conditions on wheat or corn stubble.

### **Synchrony XP** chlorimuron (2) + thifensulfuron (2)

**Rate:** 0.375 oz/a

**Adjuvants:** On conventional varieties, add nonionic surfactant at 0.25% to the spray mixture, plus either 2-4 qt/a of 28% nitrogen solution, 1-2 qt/a of 10-34-0, or 2-4 lb/a of ammonium sulfate. On Roundup Ready soybean, add 0.25% nonionic surfactant when mixed with glyphosate plus ammonium sulfate at 4.25-17 lb/100 gal.

**Crop stage:** Apply after the first trifoliate leaf stage and 60 days before harvest.

**Remarks:** At 0.375 oz/a, only pigweed, cocklebur,

and sunflower are listed as controlled. Lambsquarters, smartweed, and velvetleaf control can be improved with the addition of 0.06 oz/a Harmony SG; common ragweed and velvetleaf control can be improved with 0.15 oz/a FirstRate; and waterhemp, common ragweed, nightshade, and velvetleaf control can be improved with 1 pt/a Flexstar. Synchrony will not control nightshade by itself. Non-ST5 soybean varieties may be slightly stunted by Synchrony.

### **Tavium** dicamba (4) + S-metolachlor

**Burndown rate:** 56.5 fl oz/A in dicamba tolerant (DT) and non-DT soybean.

**PRE/POST rate:** 56.5 fl oz/A on dicamba tolerant soybean only.

**Adjuvants:** NIS at 0.25% v/v or a COC, MSO at 0.5-1% v/v. Do not use COC or MSO for POST applications of Tavium due to potential crop injury. Required for all applications: an approved drift reduction agent (DRA) PLUS an approved volatility reduction agent (VRA), like VaporGrip Xtra. See [www.TaviumTankMix.com](http://www.TaviumTankMix.com) for a current list of approved adjuvants. Do NOT apply Tavium with ammonium containing adjuvants, conditioners, or fertilizers.

**Crop Stage:** In *DT soybean*, apply Tavium within 45 days of planting through V4 soybean OR up to and including June 30, whichever occurs first. In *non-DT soybean*, apply at least 28 days prior to soybean planting.

**Weed Timing:** For best results apply to emerged broadleaf weeds less than 4-inches in height. Tavium will not control emerged grass weeds and should be tank-mixed with an approved glyphosate or group 1 herbicide. Dicamba also provides moderate residual control/suppression of some broadleaf weeds. The S-metolachlor component provides residual control of grass and certain small seeded broadleaves.

**Remarks:** In certain counties, a 57 ft omnidirectional in-field buffer is required to protect federally listed threatened and endangered species. You must obtain an Endangered Species Bulletin for the month you plan to apply via the EPA website, [www.epa.gov/endangered-species](http://www.epa.gov/endangered-species). Many additional stewardship practices are required to mitigate the risk for off-target movement of dicamba. Please thoroughly read the most current label for details. Only tank mix partners and nozzles approved by the EPA may be used. See [www.TaviumTankMix.com](http://www.TaviumTankMix.com) for a current list of approved tank mix partners and nozzles. 56.5 fl oz/a is the maximum rate that can be applied in a single application. No more than 56.5 fl oz/a can be applied in one season. Do not apply less than 56.5 fl oz/a.

**Tendovo** S-metolachlor (15) + metribuzin (5) + cloransulam (2)

**Rate:** 1.2-2.35 qt/a. Rate dependent on soil texture, *coarse soil*: 1.2-1.5 qt/a; *medium soil*: 1.5-2.1 qt/a; *fine soil*: 1.75-2.35 qt/a. Use the higher rate within the range in fields with a history of severe weed pressure, when organic matter is greater than 3%, and/or when heavy crop residues are present on the soil surface.

**Adjuvants:** The use of an adjuvant is only necessary in burndown applications with certain tank-mix partners. Consult the labels of all products in the tank-mix for adjuvant recommendations.

**Crop stage:** Apply from 45 days before planting up to but before soybean emergence. For PPI applications, incorporate into the top 2 inches of soil within 14 days before planting.

**Weed timing:** Provides residual control/suppression of many annual broadleaves and grasses. Length of residual control will depend on the rate used. The addition of cloransulam to the premix greatly improves control of certain large seeded broadleaves such as cocklebur, velvetleaf, and giant ragweed relative to Boundary. The metribuzin and cloransulam components of Tendovo will also provide enhanced burndown control of several broadleaves; however, burndown applications should include an appropriate tank mix partner for adequate control (see label for recommendations).

**Remarks:** Tendovo may injure soybean due to the metribuzin component. The risk of soybean injury increases when soybeans are planted less than 1.5 inches deep or when heavy rains follow application. Use should be avoided on soils with less than 0.5% organic matter, on soils with a pH of 7.5 or higher, and in fields where residues of atrazine exist.

**Treflan** trifluralin (3)

**Rate:** 1-2 pt/a of 4 lb/gal formulation or equivalent.

**Crop Stage:** Apply to dry soil within the several weeks before planting. Incorporate into the top 2-3 inches of soil within 24 hours after application. Prompt incorporation is important.

**Remarks:** Trifluralin does not control black nightshade, cocklebur, wild mustard, common ragweed, smartweed, or velvetleaf. Trifluralin can be tank mixed with Command or metribuzin. It is ineffective on peat or muck soils. Soybean injury doesn't appear to be a problem except when trifluralin is applied to wet soils or in areas subject to prolonged flooding. Trifluralin can cause stunted soybean plants with swollen crowns and inhibited secondary roots. It can be mixed with liquid fertilizers or impregnated onto certain dry fertilizers for simultaneous application.

**Trivence** chlorimuron (2) + flumioxazin (14) + metribuzin (5)

**Rate:** 6 oz/a: Apply no more than 2.5 oz/a if treating at least 1 day prior to planting. Rates of up to 3.75 oz/a can be used if applying at least 7 days prior to planting.

**Adjuvants:** COC, NIS. Add crop oil concentrate or methylated seed oil at 1% unless tank mix herbicide label doesn't allow then use a nonionic surfactant at 0.25%.

**Crop stage:** Anytime prior to or up to 3 days after soybean planting. Do not apply to soybean that have either cracked or emerged as severe injury will occur.

**Weed timing:** Tank mix other herbicides to control, if weed size exceeds 3 inches.

**Remarks:** Provides selective burndown plus residual weed control of many broadleaf weeds and partial control of grasses. For season-long control of grasses POST treatments will be needed. Do not tank mix or apply any Organophosphate insecticides at planting or within 14 days of planting or injury may result. See label for additional restrictions with respect to other herbicide uses in fields treated with this product.

**Ultra Blazer** acifluorfen (14)

**Rate:** 1.0-1.5 pt/a

**Adjuvants:** Add NIS at 0.125-0.25% or COC at 1-2 pt/a PLUS 2-4 qt/a of 28% nitrogen solution or 2.5 lb/a ammonium sulfate to the spray mixture.

**Crop stage:** Apply in the 1-2-trifoliate leaf stage to ensure good spray coverage of weeds. Apply 50 days before harvest.

**Weed timing:** The maximum leaf stage is 2 or 4 leaves for most weeds listed for control.

**Remarks:** Ultra Blazer can be tank mixed with Basagran, Classic, FirstRate, glyphosate, Harmony SG, Pursuit, Raptor, Resource, and the post-emergence grass herbicides. Soybean treated with Ultra Blazer almost always show some leaf speckling, crinkling, and bronzing, especially on the youngest leaves. Soybean generally outgrow this condition. Do not apply to soybean that are under stress from weather extremes or injury from another herbicide. Because Ultra Blazer has contact action, weeds must be thoroughly covered with spray. Use 10-20 gal/a of water and a minimum of 40 psi pressure through flat fan or hollow cone nozzles spaced 20 inches apart. Do not apply if wind exceeds 15 mph.

**Valor SX/Valor EZ** flumioxazin (14)

**Rate:** Valor SX: 2-3 oz/a; Valor EZ: 2-3 fl oz/a.

**Adjuvants:** Add COC or MSO at 1-2 pt/a or NIS at 0.25% v/v in burndown applications to enhance the control of emerged weeds. AMS at 2-2.5 lbs/a

or 28-32% UAN at 1-2 qts/a may be added can also be added.

**Crop stage:** Apply before planting or within 3 days after planting. Do not incorporate Valor or apply if soybean seedlings are emerging.

**Weed timing:** Provides residual control/suppression of many broadleaf weeds and suppression of some grass species. Valor SX/Valor EZ can be tank mixed with other preemergence grass herbicides to improve grass control (see remarks for restrictions). Rates lower than 2 fl oz/a will not provide residual control. Valor SX/Valor EZ can provide for increased burndown activity of some broadleaf weeds; however, it is not intended to replace an appropriate preplant burndown program. See label for preplant burndown tank mixes.

**Remarks:** Valor is not labeled to control weeds on soils with greater than 5% organic matter. Do not mix with products containing alachlor, metolachlor, flufenacet, or dimethenamid when applied within 14 days of planting unless soybeans are planted under no-till or minimum till conditions in wheat or corn stubble. To reduce the risk of injury, plant soybean at least 1.5 inches deep. Rain splatter may cause speckling of soybean plants.

**Valor XLT** flumioxazin (14) + chlorimuron (2)

**Rate:** 2.5-5 oz/a. Do not apply more than 2.5 oz/a on soils with a pH >7.

**Adjuvants:** Add 1-2 pt/a COC or 0.25% NIS in burndown applications. AMS at 8.5-17 lb/100 gal may also be added in addition to the COC or NIS.

**Crop stage:** Apply in the fall after soil temperature is below 50°F or October 15 or in the spring either before planting or within 3 days after planting. Do not incorporate Valor XLT or apply if soybean seedlings are emerging.

**Weed timing:** Provides residual control/suppression of many broadleaf weeds and suppression of some grass species. Valor XLT can be tank mixed with other preemergence grass herbicides to improve grass control (see remarks for potential injury concerns). Valor XLT will also provide burndown control of several broadleaf weeds including dandelion, but treatments should also include appropriate tank mix partner (see label for recommendations).

**Remarks:** Can only be applied south of I-90 west of Madison and south of I-94 east of Madison. Do not tank mix with with chloracetamide containing products such as Dual II Magnum or Outlook. Do not use on soil with a pH greater than 7.6.

**Verdict** saflufenacil (14) + dimethenamid-P (15)

**Rate:** 5-10 fl oz/a; Applying 5 fl oz/a requires 30 days preplant interval on course soils with 2% organic matter and 0 days on other soils. 7.5 fl

oz/a requires 30 days preplant interval on course soils with 2% organic matter and 14 days preplant on other soils. 10 fl oz/a requires 44 days preplant interval on course soils with 2% organic matter and 30 days preplant on other soils.

**Adjuvants:** Add MSO at 1% v/v plus AMS at 8.5-17 lb/100 gal or UAN at 1.25-2.5% v/v in burndown situations.

**Crop stage:** Apply before planting up to 3 days after planting. Application timing will depend on rate used and soil properties. Do not apply to emerged soybean as severe injury will occur.

**Weed timing:** Verdict can aid in the burndown of emerged broadleaf weeds prior to planting, especially marestail. It can be tank mixed with Gramoxone, glyphosate, or glufosinate to increase burndown activity and to control emerged grasses. It can also be mixed with 2,4-D in early preplant applications; however, plant-back restrictions of 2,4-D must be followed. Verdict will also provide some residual control of some broadleaf and grass weeds but will not provide season-long control. **Remarks:** Verdict is a premix of Sharpen and Outlook herbicides. At the 5 oz/a rate Verdict provides the equivalent of 1 oz/a Sharpen and 4.2 oz/a Outlook. Verdict can be used in sequential applications with Sharpen, but longer plant-back restrictions are needed for higher rates of saflufenacil, and season limits of saflufenacil cannot be exceeded. Do not apply Verdict within 30 days of other Group-14 herbicides (sulfentrazone, flumioxazin) as severe crop injury may result. Do not use on sands with less than 3% organic matter and where depth to ground water is 30 ft or less.

**Vida** pyraflufen (14)

**Rate:** 0.5-2.0 fl oz/a

**Adjuvants:** Add NIS at 0.5% v/v or COC at 1% v/v

**Weed timing:** Apply to emerged broadleaf weeds before they exceed 4 inches in height or 3 inches in rosette diameter and prior to soybean planting.

**Remarks:** This is a contact herbicide that will control many emerged annual broadleaf weeds. Only the top growth of perennials will be controlled. Vida can be tank mixed with glyphosate for grass control or added control of larger broadleaf weeds. Vida can also be mixed with 2,4-D or other residual herbicides. Good spray coverage is necessary for good weed control.

**Warrant** acetochlor (15)

**Rate:** 1.25-2.0 qt/a; Maximum allowable rate is based on % organic matter and soil texture, see label for details

**Crop stage:** Apply anytime from before planting up to the R2 soybean growth stage. Do not incor-

porate preplant applications. The optimum timing for POST applications is when soybeans are V2-V3. Directed applications may be used to increase soybean canopy penetration after V5.

**Weed timing:** Warrant will provide residual control of annual grasses and some small-seeded broadleaves but will not control emerged weeds. Warrant can be tank-mixed with several PRE and POST soybean herbicides to broaden the spectrum of residual control and to control emerged weeds (see label for tank-mix recommendations).

**Remarks:** Warrant is an encapsulated formulation of acetochlor. More than one application of Warrant can be made per year, but do not exceed 4 qts/a in a year when making a second application.

**Warrant Ultra** acetochlor (15) + fomesafen (14)

**Rate:** 48-60 fl oz/a; South of highway 18 between Prairie Du Chien and Madison and interstate 94 between Madison and Milwaukee can apply up to 60 fl oz/A. South of interstate 94 from Minnesota to Eau Claire and south of highway 29 from Eau Claire to Green Bay plus Barron, Chippewa, Clark, Door, Dunn, Eau Claire, Kewaunee, Marathon, Menominee, Oconto, Polk, Shawano, and St. Croix counties are limited to 48 fl oz/a or prohibited from using (see label for details). Warrant Ultra is not registered for use in Adams, Marquette, Portage, Waupaca, Waushara, and Wood counties or in northern Wisconsin.

**Adjuvants:** Add NIS at 0.25-0.5% v/v or COC or MSO at 0.5-1% v/v if Warrant Ultra is being used to control emerged weeds.

**Crop stage:** Apply anytime from before planting up to the R2 soybean growth stage. Do not incorporate preplant applications. The optimum timing for POST applications is when soybeans are V2-V3.

**Weed Timing:** Warrant Ultra will provide residual control/suppression of many annual grasses and broadleaves. The fomesafen (Flexstar) component of Warrant Ultra also provides control of some emerged broadleaves. For best POST control, include the appropriate adjuvant and apply to small, actively growing weeds.

**Remarks:** Warrant Ultra can only be applied once per growing season. When applying other acetochlor-containing products in the same field, do not exceed the maximum annual rate of 3 lbs/a per season of acetochlor.

**Xtendimax** dicamba (4)

**Burndown/PRE rate:** 22-44 fl oz/A in dicamba tolerant (DT) soybean.

5.5-22 fl oz/A in non-DT soybean.

**POST rate:** 22 fl oz/A – dicamba tolerant (DT)

soybean only.

**Adjuvants:** Required for all applications: an approved drift reduction agent (DRA) PLUS an approved volatility reduction agent (VRA), like VaporGrip Xtra. See <http://www.xtendimax-applicationrequirements.com> for a current list of approved adjuvants. Do NOT apply Xtendimax with ammonium containing adjuvants, conditioners, or fertilizers.

**Crop Stage:** In DT soybean, apply to emerging weeds from preplant up to but prior to R1 (beginning flower) soybean OR up to and including June 30, whichever occurs first. In non-DT soybean, apply at least 14 days prior to soybean planting if using the 5.5-11 fl oz/a rate, and at least 28 days if using a rate of 11.1-22 fl oz/a.

**Weed Timing:** For best results apply to emerged, actively growing weeds that are 4-inches or less in height. Xtendimax also provides moderate residual control of some broadleaf weeds. Level of residual control is dependent on the rate used. Xtendimax does not provide control of emerged grasses and should be tank-mixed with an approved glyphosate or group 1 herbicide.

**Remarks:** In certain counties, a 57 ft omnidirectional in-field buffer is required to protect federally listed threatened and endangered species. You must obtain an Endangered Species Bulletin for the month you plan to apply via the EPA website, [www.epa.gov/endangered-species](http://www.epa.gov/endangered-species). Many additional stewardship practices are required to mitigate the risk for off-target movement of dicamba. Please thoroughly read the most current label for details. Only tank mix partners and nozzles approved by the EPA may be used. See <http://www.xtendimax-applicationrequirements.com> for a current list of approved tank mix partners and nozzles. No more than 44 fl oz/a (DT soybean) and 22 fl oz (non-DT soybean) can be applied at preplant/preemergence. 22 fl oz/A is the maximum rate that can be applied in a single, in-crop application. No more than 44 fl oz/a can be applied in-crop in a single year.

**Zidua/Zidua SC** pyroxasulfone (15)

**Preplant/PRE:** Zidua: 1.5-3.5 oz/a; Zidua SC: 2.5-5.75 fl oz/a. Rates are based on soil texture and application timing, see label of each product for details.

**POST:** Zidua: 1.0-3.5 oz/a; Zidua SC: 1.75-5.75 fl oz/a. Rates are based on soil texture, see label of each product for details.

**Crop stage:** Fall, Preplant, PRE, POST. Can be applied POST to soybean from cracking through the V3 growth stage.

**Weed timing:** Provides residual control of annual grasses and small-seeded broadleaf weeds. Will not control emerged weeds.

**Remarks:** 3 oz/a Zidua = 4.9 fl oz Zidua SC. Zidua can be applied with water or various fertilizer combinations; see label for details. Zidua can be mixed with one or more herbicide products according to both the Zidua and tank-mix partner labels. Zidua can be applied in the fall or early preplant up to 45 days before planting. Use the higher application rates in these scenarios. A lower rate can be used if a sequential application is planned. On coarse soil, do not apply more than a cumulative amount of 0.112 lb pyroxasulfone/a (Zidua: 2.1 oz/a; Zidua SC: 3.5 fl oz/a) per year. On all other soil textures, do not apply more than a cumulative amount of 0.186 lb pyroxasulfone/a (Zidua: 3.5 oz/a; Zidua SC: 5.75 fl oz/a)

**Zidua PRO** pyroxasulfone (15) +  
saflufenacil (14) + imazethapyr (2)

**Burndown Rate:** 6 fl oz/a

**PRE:** 4.5-6 fl oz/a; Rate based on tillage system and weed pressure. The 6 fl oz/a rate is recommended for fields with high weed pressure and no-till fields.

**Adjuvants:** When applying Zidua PRO to emerged weeds, add MSO at 1% v/v plus AMS at 8.5-17 lbs/100 gals or UAN at 1.25-2.5% v/v. Use AMS fertilizer when mixing Zidua PRO with glyphosate-based herbicides. Do not use NIS as a substitute for MSO or poor performance on broadleaf weeds will occur.

**Crop Stage:** Apply preplant or preemergence. Do not apply Zidua PRO to emerged soybean, as severe crop injury will occur. Zidua PRO may be applied in the fall and/or the spring for burndown and/or residual weed control. Fall applications must be made prior to the first killing frost.

**Weed timing:** Zidua PRO provides both burndown and residual preemergence control of annual grass and broadleaf weeds. Burndown applications must be made when weeds are small and actively growing and must include the recommended adjuvant system.

**Remarks:** Zidua PRO may only be applied using water as the carrier. Depending on soil texture and organic matter, a minimum preplant interval may be required (see label for details).

**Table 3-2.** Rate equivalents of soybean herbicide premixes

Herbicide	Rate/a	Provides the equivalent of:
Afforia 50.8% DG	3 oz	2.4 oz Valor SX 51WDG + 0.3 oz Express 50SG + 0.3 oz Harmony 50SG
Anthem	6 oz/a	3 fl oz Zidua 4.17SC + 0.42 fl oz of Cadet
Anthem Maxx	3 oz/a	3 fl oz Zidua 4.17SC + 0.42 fl oz of Cadet
Authority Assist	6 fl oz	5 fl oz Spartan 4L + 2 fl oz Pursuit 2S
Authority Elite/ BroadAxe XC	25 fl oz	4.37 fl oz Spartan 4L + 1.3 pt Dual II Magnum 7.64EC
Authority First/Sonic	6.45 oz	8 fl oz Spartan 4L + 0.61 oz FirstRate 84DF
Authority MTZ	12 oz	4.3 fl oz Spartan 4L + 4.3 oz Metribuzin 75DF
Authority Maxx	5 oz/a	6.2 oz Spartan 4L + 0.78 oz Classic
Authority Supreme	8 fl oz/a	4.2 fl oz Spartan 4L + 4 fl oz Zidua 4.17SC
Boundary 6.5EC	2 pt	1.3 pt Dual II Magnum 7.64EC + 6.67 oz Metribuzin 75DF
Canopy EX 29.5DF	1.1 oz	1.0 oz Classic 25DF + 0.15 oz Express 50SG
Canopy 75DF	2.25 oz	1 oz Classic 25DF + 1.9 oz Metribuzin 75DF
Canopy Blend 58.3 WDG	2.9 oz	1 oz Classic 25 DF + 1.9 oz Metribuzin 75DF
Enlist Duo	4.75 pt	0.95 lb ae 2,4-D + 1.01 lb ae glyphosate
Enlite	2.8 oz	2 oz Valor SX + 0.3 oz Classic 25DF + 0.5 oz Harmony SG
Envive	2.5 oz	1.4 oz Valor SX + 0.9 oz Classic 25DF + 0.14 oz Harmony SG
Extreme 2.17SC	3 pt	4 fl oz Pursuit 2S + 0.56 lb ae glyphosate
Fierce EZ	6 fl oz	2 oz Valor SX 51DF + 1.5 oz Zidua 85WG
Fierce MTZ/Kyber	1 pt	2 oz Valor SX 51DF + 1.5 oz Zidua 85WG + 4 oz Metribuzin 75DF
Fierce XLT	3.75 oz	1.9 oz Valor SX + 0.94 oz Classic 25DF + 1.4 oz Zidua 85WG
Flexstar GT 3.5	3 pt	1 pt Flexstar 1.88SL + 1 lb ae glyphosate
Fusion 2.56EC	8 fl oz	8 fl oz Fusilade DX 2EC + 6.7 fl oz Option II 0.67EC
Marvel 3L	7 fl oz	0.9 fl oz Cadet 0.91EC + 0.67 pt Flexstar 1.88SL
Matador	2 pt	16.75 fl oz Dual II Magnum 7.64EC + 2 fl oz Pursuit + 3 oz Metribuzin 75DF
Panther PRO	12 fl oz	2 fl oz Panther SC + 3.2 fl oz Pursuit + 6 oz Metribuzin 75DF
Prefix	2 pt	1.1 pt Dual II Magnum 7.64EC + 1 pt Flexstar
Preview	21 fl oz	5.9 fl oz Spartan 4L + 7.8 oz Metribuzin 75DF
Sequence 5.25EC	3 pt	1.3 pt Dual II Magnum 7.64EC + 1 lb ae glyphosate
Surveil	4.2 oz	0.6 oz FirstRate + 3 oz Valor SX
Synchrony XP	0.375 oz	0.32 oz Classic 25DF + 0.05 oz Harmony 50SG
Tavium	56.5 fl oz	22 fl oz Xtendimax 2.9L + 16.7 fl oz Dual II Magnum 7.64EC
Tendovo	2.1 qt	1.9 pt Dual II Magnum 7.64EC + 7.2 oz Metribuzin 75DF + 0.65 oz FirstRate 84DF
Tripzin ZC	44 fl oz	8 oz Metribuzin 75DF + 2.1 pt Prowl H <sub>2</sub> O 3.8CS
Trivence 61.3DG	6 oz	0.94 oz Classic 25DF + 1.5 oz Valor SX 51DF + 3.6 oz Metribuzin 75DF
Valor XLT	2.5 oz	1.5 oz Valor SX + 1 oz Classic 25DF
Verdict	5 fl oz	1 fl oz Sharpen + 4.2 fl oz Outlook 6EC
Warrant Ultra	60 fl oz	3.5 pt Warrant + 20 fl oz Flexstar
Zidua 85WG	3 oz	4.9 fl oz Zidua 4.17SC
Zidua PRO	4.5 fl oz	0.75 fl oz Sharpen + 3 fl oz Pursuit + 2.5 fl oz Zidua 4.17SC

**Table 3-3.** Forage and grain harvest intervals for soybean herbicides<sup>a</sup>

Herbicide	PHI grain (days)	PHI forage/ grazing/silage (days)
Afforia	0	not permitted
Anthem	70	not permitted
Anthem Maxx	60	not permitted
Assure II	80	not permitted
Authority Assist	0	not permitted
Authority Elite	30	30
Authority First	65	not permitted
Authority MTZ	0	not permitted
Authority Maxx	0	not permitted
Authority Supreme/Edge	0	not stated
Autumn Super 51 WDG	0	45
Basagran	30	30
Boundary 6.5 EC	75	40
Broadaxe XC	30	30
Cadet	60	not permitted
Canopy Blend	0	not permitted
Canopy EX	0	14
Classic	60	not permitted
Cobra	45	not permitted
Dual II Magnum	75	30 <sup>c</sup> ; not permitted
Engenia	7	7 <sup>b</sup>
Enlist Duo	30	not permitted
Enlist One	30	not permitted
Enlite	0	not permitted
Envive	0	not permitted
Extreme	85	not permitted
Fierce/Fierce EZ	0	not permitted
Fierce MTZ/Kyber	0	40
Fierce XLT	0	not permitted
FirstRate	70	25
Flexstar	45	not permitted
Flexstar GT 3.5	45	not permitted
Fusilade DX	60	not permitted
Fusion	before bloom	not permitted
Gramoxone SL 3.0	15	see label
Harmony SG	60	not permitted
Liberty 280 SL	70	not permitted
Lorox	0	not permitted

Herbicide	PHI grain (days)	PHI forage/ grazing/silage (days)
Marvel	60	not permitted
metribuzin	0	45
Outlook	0	not permitted
Panther PRO	85	not permitted
Phoenix	45	not permitted
Poast Plus	75	75
Prefix	75	not permitted
Preview 2.1SC	0	no permitted
Prowl H2O	0	0
Pursuit	85	not permitted
Python	85	not permitted
Raptor	0	0
Resource	60	not permitted
Roundup PowerMAX	7-14	14-25
Select Max	60	not permitted
Sequence	75	not permitted
Sharpen	0	65
Sonic	65	not permitted
Surveil	65	not permitted
Synchrony XP	60	not permitted
Tavium	90	30 <sup>c</sup> ; not permitted
Tendovo	75	40
Treflan	0	0
Trivence	0	not permitted
Ultra Blazer	50	not permitted
Valor SX	0	not permitted
Valor XLT	0	not permitted
Verdict	0	80
Vida	70	7
Warrant	0	not permitted
Warrant Ultra	45	not permitted
Xtendimax	7	7 <sup>b</sup>
Zidua/Zidua SC	0	not stated
Zidua PRO	85	not permitted

<sup>a</sup> Labels may have changed after this table was prepared. Consult current labels to verify the information.

<sup>b</sup> Only legal with dicamba tolerant soybeans

<sup>c</sup> Following preplant or preemergence application. Feeding treated forage or hay is not permitted following a postemergence application.

**Table 3-4.** Rainfree period and adjuvants required for postemergence soybean herbicides

Herbicide	Hours rainfast	Recommended adjuvants				
		Nonionic surfactant		Crop oil concentrate		Nitrogen additive
Anthem/ Anthem Maxx	4	0.25%	or	1-2 pt/a COC or MSO		
Assure II	1	0.25%	or	1%		
Basagran <sup>a</sup>	4			1 qt/a	or	28% N at 2-4 qt/a or AMS at 2.5 lb/a
Cadet	4	0.25%	or	1-2 pt/a	plus	28% N at 1-2 qt/a or AMS at 1-2 lb/a may be added
Classic	1	0.25%	or	1% if hot, dry		Also add 28% N at 2-4 qt/a or AMS at 2-4 lb/a for velvetleaf
Cobra <sup>b</sup>	0.5	0.25% if high RH	or	0.25-1.0%	or	28% N at 1 gal/a or AMS at 2-4 lb/a plus NIS or COC
Engenia	4	Consult <a href="http://www.engeniatankmix.com">www.engeniatankmix.com</a> for recommendations				
Extreme	1	0.125%			plus	AMS at 2.5 lb/a or 28% N at 1-2 qt/a
FirstRate	2	0.125-0.25%	or	1.2%		Add 28% N at 2.5% or AMS at 2 lb/a when using nonionic surfactant
Flexstar	1	0.25-0.5%	or	0.5-1.0%	plus	28% N at 2.5% or AMS at 10 lb/100 gal
Flexstar GT	1					AMS at 8.5-17.0 lb/100 gal may be added
Fusilade DX	1			0.25%		
Fusion	1	0.25-0.5%	or	0.5-1.0%		28% N at up to 4% may be added
Gramoxone SL 3.0 - preharvest	0.5	0.25%	or	1%		
Harmony SG	1	0.25-0.5%	or	0.5% if cool, dry	plus	28% N at 2-4 qt/a or 10-34-0 at 1-2 qt/a or AMS at 2-4 lb/a
Liberty 280 SL	4					AMS at 2-4 lb/a
Marvel	1	0.25-0.5%	or	0.5-1.0%	plus	28% UAN at 1-2 qt/a or AMS at 2-4 lb/a
Phoenix	1	0.125-0.25%				
Poast Plus	1			1 qt/a		28% N at 2-4 qt/a or AMS at 2.5 lb/a <sup>c</sup>
Prefix	1	0.25%				
Pursuit	1	0.25%	or	1% COC or MSO	plus	28% N or 10-34-0 at 1-2 qt/a or AMS at 2.5 lb/a
Raptor	1	0.25%	or	1% COC or MSO	plus	28% N or 10-34-0 at 1-2 qt/a or AMS at 2.5 lb/a
Resource	1			1 qt/a		
Roundup PowerMAX	0.5					AMS at 8.5 to 17 lb/100 gal
Select Max	1	0.25%	or	1 qt/a	plus	AMS at 2.5 lb/a
Sequence	—					AMS at 8.5 to 17 lb/100 gal
Synchrony XP	1	0.25% if non-STs variety	or	1% if STs variety	plus	28% N at 2-4 qt/a or 10-34-0 at 1-2 qt/a or AMS at 2-4 lb/a
Tavium	—	0.25%		Consult <a href="http://www.TaviumTankMix.com">www.TaviumTankMix.com</a> for recommendations		
Ultra Blazer	4	0.125-0.25%	or	1-2 pt/a	or	28% N at 2-4 qt/a or AMS at 2.5 lb/a
Warrant Ultra	1	0.25-0.5%	or	0.5-1.0%		
Xtendimax	4	Consult <a href="http://www.xtendimaxapplicationrequirements.com">www.xtendimaxapplicationrequirements.com</a> for recommendations				

Abbreviations: AMS = ammonium sulfate; COC = crop oil concentrate; MSO = methylated seed oil; N = Nitrogen; NIS = nonionic surfactant; RH = relative humidity; STS = sulfonyleurea-tolerant

<sup>a</sup> Add COC for lambsquarters and common ragweed control, add a nitrogen additive for velvetleaf control, or add both if all three weeds are present.

<sup>b</sup> Adjust adjuvant type and rate based on RH. See label for recommendations.

<sup>c</sup> Add a nitrogen additive plus COC when controlling volunteer corn or large crabgrass.

# Soybean insect management

Insecticides suggested in this section are intended as a guide to assist you in selecting chemical insect control options. While suggestions provide an overview of product registrations for specific field crop insect pests, this guide is not intended as an exhaustive label source. Product inclusion or omission does not imply endorsement by the University of Wisconsin-Extension. Proper and safe insecticide use requires great care and strict adherence to the most current label directions. Label changes and occasional-use cancellations may have occurred since the writing of this publication.

As of this publication date, EPA has revoked all tolerances for the use of chlorpyrifos in feed and food crops effective February 28, 2022. All insecticides containing this active ingredient have been removed from this list.

A number of the products listed in this section are restricted-use insecticides. We discuss restricted-use pesticides in the beginning of this publication. Refer to appendix table 7-2 for a list of insecticides that currently require certification to be applied. It is possible that additional insecticides will be classified before the next growing season. Contact your county Extension agent for additional information on insecticide restriction.

Insecticides applied at pest insect economic thresholds help control insect pests, but they also kill beneficial

insect predators and parasitoids that are important in biological control. Insecticides such as Sevin XLR Plus (carbaryl) are hazardous to honeybees. For these and all insecticides, follow label directions. Where required by label, notify local beekeepers when using such products and do not apply or allow product to drift onto blooming crops and/or weeds when bees are foraging in the area to be treated.

See the discussion on reducing insecticide hazards to bees in **Forage Insect Management** for more information.

## Insect pests

### Bean leaf beetle

Bean leaf beetle population densities have increased in the Midwest following recent mild winters. Although pod feeding has been noted as far north as Chippewa County, defoliation and disease transmission (bean pod mottle virus) is of greater concern in the southernmost counties.

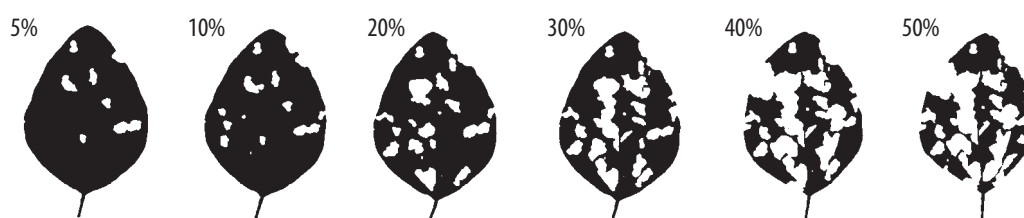
Adult beetles are ¼ inches long, about the size of lady beetles. Wing covers are typically light yellow with a black margin and four black spots. Variations include crimson wing covers with spots or light yellow wing covers with no spots. There is always a black triangle behind the “neck” region (prothorax). Beetles readily drop from the plant if they detect disturbance.

Adults overwinter under leaf debris near soybean fields. Once they become active in the spring, the beetles feed on wild legumes, alfalfa, and clover. As soybean begin to emerge, beetles leave these alternate hosts and concentrate on soybean seedlings. Thus, the earliest planted fields are at greatest risk from feeding damage and virus transmission. Bean leaf beetles chew round holes between the major leaflet veins. This damage is easily distinguished from that of caterpillars and grasshoppers, which chew ragged, irregular holes.

Adults lay eggs in the soil next to soybean stems. Larvae hatch about 1 week later and feed on roots and stems. Their root feeding is not believed to be of economic importance. First-generation adults appear in July, peaking during the late vegetative and early reproductive stages of soybean growth. Second-generation adults can be found from late August to mid-September, when they feed on leaves and pods. This second generation can cause significant crop damage. Beetles may clip developing pods from the plant or graze on the outer layer of the pod, leaving only a thin layer of tissue. Diseases can enter these damaged areas, and the seeds will be discolored, shrunk, and moldy.

Scout for overwintered beetles beginning shortly after soybean emerge. Count the number of beetles on each

Use this guide to help determine the extent of defoliation by leaf-feeding insects.



**Table 3-5.** Bean leaf beetle threshold for overwintering adults (per plant) in soybean

Control	VC growth stage			V1 growth stage			V2 growth stage		
	\$6	\$8	\$10	\$6	\$8	\$10	\$6	\$8	\$10
\$5/bu	2.4	3.2	4.0	3.7	5.0	6.2	5.9	7.8	9.8
\$6/bu	2.0	2.7	3.4	3.1	4.1	5.2	4.9	6.5	8.1
\$7/bu	1.6	2.2	2.8	2.5	3.2	4.2	3.9	5.2	6.4
\$8/bu	1.2	1.7	2.2	1.9	2.3	3.2	2.9	3.9	4.7
\$9/bu	0.8	1.2	1.6	1.3	1.4	1.2	1.9	2.6	3.0
\$10/bu	0.4	0.7	1.0	0.7	0.5	0.2	0.9	1.3	1.3

Source: Dr. Erin W. Hodgson, Extension Entomologist, Iowa State University

plant sampled and obtain a field average. Check again when first-crop alfalfa harvest is underway, as the activity may force beetles to move to soybean. Consult table 3-5 for guidance on when to treat.

Scout for first and second-generation bean leaf beetle using an insect sweep net. Scout each field and each variety within a field separately as beetles sometimes prefer one variety over another. Scouting is no longer necessary after pods reach the R7 (yellow pod) stage.

Consult tables 3-5, 3-6a and 3-6b for guidance on when to treat for first and second generation adults, respectively. Pod damage must also be incorporated into the second-generation threshold. Pod clipping is typically worse during dry weather as beetles move from feeding on leaves to feeding on pods. Inspect dropped pods for signs of feeding damage

(as opposed to abortion caused by drought stress).

If the beetle population is less than the economic threshold, scout the field again 5 days later. Stop scouting when beetle counts start to decline, soybean pods begin to turn yellow, or the field is sprayed.

Treatment thresholds for the prevention of bean pod mottle virus are not available.

### Brown Marmorated Stink Bug

The brown marmorated stink bug (BMSB) is a new invasive stink bug species that was first detected during 2010 in Wisconsin.

The term "marmorated" refers to the marble-like markings on the back. Adults are approximately 5/8-inch-long and have a very distinct "shield-shape". The most identifiable characteristics of the adult BMSB are

1) alternating light to brown spots on the outer edge of their abdomen 2) antennae have alternating brown and light bands and 3) the eyes of fresh specimens are dark red. Immature BMSB are smaller than the adults and range in size from a pin head to 1/2 inch in length. Nymphs are oval and have dark red eyes similar to adults. Nymphs vary in color and appearance with age. Initially, they range in color from a yellowish red to a creamy white with reddish spots just prior to turning into adults.

Wisconsin does have several native stink bug species that can be found in soybean. Differences may be subtle. Most native adult stink bugs are slightly smaller (1/2 inch) compared to BMSB (5/8 inch). All species, including BMSB, will have a very distinct "shield-shape".

BMSB has a wide host range and overwinter as adults near woodlots. Overwintering adults will become active during warm spring days and will feed and mate. There are 5 nymphal instars that feed on several crop species before turning into adults late summer. Although it is difficult to know for sure, there will likely be a single generation per year in our state.

BMSB have piercing sucking mouth parts and feed on a wide host range of plants including field, forage, vegetables, fruit and ornamentals. Damage to corn and soybean is commonly

**Table 3-6a.** Bean leaf beetle threshold for first generation adults (per 20 sweeps)

Control	\$7	\$8	\$10	\$12	\$15
\$5/bu	23.0	26.2	32.6	39.0	48.6
\$6/bu	19.3	22.0	27.3	32.6	40.6
\$8/bu	14.6	16.6	20.3	24.6	30.6
\$10/bu	11.8	13.4	16.6	19.8	24.6
\$13/bu	9.2	10.5	12.9	15.4	19.1

Source: Dr. Erin W. Hodgson, Extension Entomologist, Iowa State University

**Table 3-6b.** Bean leaf beetle threshold for second generation adults (per 20 sweeps)

Control	\$10	\$11	\$12	\$13	\$14	\$15	\$16	\$17
\$7/bu	4.45	4.89	5.34	5.78	6.22	6.67	7.11	7.56
\$8/bu	3.89	4.28	4.67	5.06	5.45	5.84	6.22	6.61
\$9/bu	3.46	3.8	4.15	4.50	4.84	5.19	5.53	5.88
\$10/bu	3.11	3.42	3.73	4.05	4.36	4.67	4.98	5.29
\$11/bu	2.83	3.11	3.40	3.68	3.96	4.24	4.53	4.81
\$12/bu	2.59	2.85	3.11	3.37	3.63	3.89	4.15	4.41
\$13/bu	2.39	2.63	2.87	3.11	3.35	3.59	3.83	4.07
\$14/bu	2.22	2.45	2.67	2.89	3.11	3.33	3.56	3.78

Source: Dr. Erin W. Hodgson, Extension Entomologist, Iowa State University

found along field edges. In soybean, economic damage is from pod and/or seed feeding and results in absent, discolored or shriveled seed. Furthermore, foliage may stay green longer.

Use a 15-inch diameter insect sweep net in soybean. Take 10 sweeps in each of 5 locations within a field. Sampling throughout the entire field is important.

Economic thresholds which are specific to BMSB have not been established. Until more is known use a threshold developed for native stink bug species. Consider treating soybean if 40 stink bugs are found/100 sweeps.

---

### Grasshoppers

Grasshoppers could be a problem during dry years. If nymphs are numerous in grassy areas, such as fencerows and roadsides adjacent to soybean, spray these areas before grasshoppers spread through the soybean field. If blooming weeds are present, notify nearby beekeepers before using an insecticide and only apply between 4 p.m. and nightfall, when bees are least likely to be foraging and exposed. Insecticidal control is most effective when used before grasshoppers are mature.

---

### Green cloverworms

Green cloverworm overwinters in the southern US, migrating north in the spring. Females lay eggs singly on the underside of soybean leaves. There are six larval instars. Fully-grown larvae are approximately 1 inch long and pale green with two horizontal stripes along each side of the body. Larvae have three pairs of legs in the middle of the body, three pairs near the head, and one pair at the hind end of the body. Two generations occur in northern states.

Defoliation due to green cloverworm should be considered together with the damage inflicted by other defoliating insects to make a management decision. Defoliation estimates should be based on the whole plant, not just the upper canopy. Management is

recommended if defoliation reaches 30% before bloom and 15-20% between bloom and pod fill. Verify that green cloverworms are present before treating.

---

### Japanese beetle

Japanese beetle adults are about ½ inches long and ⅜ inches wide, with metallic, copper-colored wing covers, and a green thorax and head. Adults emerge in late June, feed on a wide range of host plants and can move to soybean, where feeding results in leaf defoliation. During July and August, adults lay eggs in grass and turf, soybean fields, and, to a lesser extent, cornfields. Eggs hatch out into small white grubs that feed on grass roots until fall temperatures cool. Third instar grubs move down in the soil profile and are inactive during winter. In early spring, grubs feed, pupate, and then emerge from the soil as adults in late June.

Adults feed on soybean leaf tissue between leaf veins resulting in a skeletonized or lace-like appearance. The treatment threshold for Japanese beetle in soybean is based on the percentage of leaf defoliation, not the number of beetles per plant. Treatment should be considered at 30% leaf defoliation pre-bloom and 15-20% defoliation from bloom to pod fill.

It is easy to overestimate defoliation percentage; it often looks worse than it is. Use the soybean leaf defoliation guide in this section to help determine the extent of damage by defoliating insects. Be sure to assess defoliation on the entire plant, not just the top leaves. Scout leaf defoliation throughout the field, not just at the field edges, where Japanese beetle aggregation and feeding can appear more concentrated. Field edge/border treatment may be sufficient if damage is confined to this area; scout the field to assess whether a whole-field treatment is required. Beetles present in the field when treated with a foliar insecticide will be killed, but beetles

moving into treated fields after application can re-infest.

---

### Potato leafhopper

Large populations of potato leafhopper can pose a threat to soybean fields. The soybean's hairy leaves and stems usually protect it from leafhopper damage. But during years with abnormally high leafhopper populations or in fields with varieties that are less hairy, scout field to make sure the crop is not threatened. Damage appears as yellowish patches on the leaves, and leaf crinkling and cupping are usually noted. The crinkling and cupping look similar to herbicide injury. Extensive feeding by potato leafhopper can stunt plants.

Examine the leaves and stems to take whole-plant counts on plants that are 1 foot or less in height. Take samples in several areas of a field. For plants taller than 1 foot, use a 15-inch-diameter sweep net to sample the fields. Research indicates this is more accurate than taking whole plant samples. To complete one sweep, move the net in one, continuous, straight-line motion through the top 15 inches of the foliage of the row from one side of your body through the foliage in the row to the other side of your body. Continue this process until 20 sweeps have been taken in an area and take no less than five sets of 20 sweeps in a field to estimate the population density. For solid-seeded beans, cover the same area that you would for 30-inch rows.

If an average of two leafhoppers are found per plant in fields with fewer than four trifoliate leaves per plant, control may be needed. If there are six leafhoppers per plant on flowering plants, control may be needed. For a pod that is ¾ inch long on one of the four uppermost nodes of the main stem, 13 or more leafhoppers per plant may cause economic injury. Examine the leaves carefully to see if the leafhoppers are able to get through the hairs and feed on leaves before deciding to treat.

Leafhopper sampling data indicate that the number of leafhoppers recovered per sweep in soybean represents half the actual number per plant, regardless of row spacing. For example, if you have taken five sets of 20 sweeps and have an average of two per sweep, you should assume an actual average of four leafhoppers per plant. When deciding on treatment, use the estimated actual number of insects per plant.

### Seedcorn maggot

The seedcorn maggot overwinters as a pupa. Adult flies emerge in late spring around the time that soybean fields are being planted. Females lay eggs in fields with high levels of organic matter. Decaying weeds and crop residue in freshly tilled fields or application of livestock manure will make a field more attractive to egg-laying flies. Eggs hatch within a week. The white, tapered, legless maggots attack germinating seeds, feeding on the cotyledons.

Seedlings may emerge with brown feeding scars on the cotyledons or they may have no cotyledons (such shoots are called “snakeheads”). Damage typically occurs in fields with an abundance of organic matter (manure or decaying plant matter) and tends to be worse when cold, wet weather slows germination.

There are no economic thresholds for seedcorn maggot. Commercial seed treatments (e.g., CruiserMaxx) are available when planting soybean to fields with high organic matter.

### Slugs

“Slug” is a common name given to a group of terrestrial organisms in the phylum Mollusca and are often referred to as “snails without a shell”. Slugs are soft-bodied, legless, slimy and may be light to dark colored. Most slugs are herbivorous and will feed on a variety of broadleaf and grass plants including corn and soybean. Slugs may be found in small grains and alfalfa, however, rarely are

they of economic importance. Feeding may be of economic importance under no-till conditions and/or high weed pressure.

Life stages may not always be synchronized, allowing for various life stages to be present at the same time. It is possible for slugs to overwinter as adults, juveniles and eggs. However, in cold winters without snow cover, eggs offer the best chance of survival. Slug development, life cycle and overwintering survival has not been well researched in Wisconsin.

Slugs have a “rasp-like” mouthpart called a radula and damage soybean plants by scraping off leaf tissue. Slugs feed nocturnally and occasionally on cool, cloudy days. During daylight hours they hide under soil clods and plant debris.

Initiate scouting for slugs in field areas with a history of slug feeding and or fields with weed or crop residue. Look through debris for eggs, juveniles and/or adults in early spring when soybean are emerging. Record percentage of plants effected, degree of defoliation and identify those field areas where slug activity is present. Economic thresholds have not been established.

When slug populations are heavy, soybean stand loss is possible. Reducing crop residue through primary or secondary tillage, including row cleaners for strip-tillage, can be effective. However, many growers with slug problems may be committed to reduce or no-tillage because of conservation plans. Early planting may give soybean an early start and might be able to outgrow some slug damage. Slugs have several natural enemies including ground and rove beetles, centipedes, spiders and several other invertebrate predators. Insecticides do not control slugs.

### Soybean aphid

#### Aphid identification and life cycle.

Soybean aphids (*Aphis glycines*) are about 1/16-inch long and green to yellowish-green in color. They are the

only aphid species known to infest and reproduce on soybean in the U.S. Early in the growing season, populations are found predominately on the underside of new leaves. As the season progresses, colonies can be found on leaves within the canopy, moving to stems and petioles when populations are high.

The soybean aphid life cycle is complex, with both sexual and asexual phases, depending on the time of year and the host plant. They overwinter in the egg stage on buckthorn, the aphid’s only known overwintering host. From spring to late summer, the aphids are all female and give birth to live females, allowing for exponential population growth. In the spring, winged females migrate from buckthorn to soybean, where multiple generations are produced. During the summer, both winged and wingless forms can be found on soybean. The winged aphids fly to other soybean fields to colonize. In the fall, male and female winged aphids migrate back to buckthorn where mating and egg laying occurs.

Aphids use piercing-sucking mouthparts to remove plant sap. Feeding damage results in stunting and yield loss. They can also transmit soybean viruses as they probe and feed between infected and uninfected plants. In addition, they excrete a sugary substance referred to as “honeydew.” If aphid populations are high, affected plants may take on a sooty appearance late in the summer as mold grows on the excrement.

Summer migrants (winged females) seem to prefer late-planted soybean, rather than early-planted soybean fields. Expect higher infestations on soybean planted after early June compared to soybean planted between late April and mid-May.

Natural enemies (predators and parasitic wasps) are an important component of soybean aphid management. Predators such as lady beetles (larvae and adults), green lacewings (larvae), and minute pirate bugs (nymphs and adults) consume soybean aphids.

Parasitic wasps lay eggs inside aphids. The developing wasp larva kills the host from within. The adult wasp emerges, leaving behind a hollowed-out shell referred to as an aphid “mummy.” Parasitized aphids are tan to dark brown and stick to the underside of soybean leaves. Another natural control agent is a fungal pathogen that can cause an epidemic in the soybean aphid population.

**Soybean aphid treatment decisions.** Treatment decision guidelines are summarized as follows:

- **Avoid treating soybean aphids when they first appear in a field.** Insecticide applications to control low and nondamaging populations will enhance resistance and also kill beneficial insects, allowing surviving aphids and migrants to more readily repopulate the field. Soybean aphids reproduce much faster than lady beetles and other beneficial insects. Thus, early-season treatments can lead to higher populations than if the field had not been sprayed.
  - **Scout fields weekly to determine the rate of population increase.** Begin intensive scouting no later than the mid-vegetative stages of soybean growth, typically around mid- to late-June. Count the number of aphids present on 20-30 plants per field. Examine the entire plant for aphids, paying close attention to the upper leaves and stems where aphids congregate. Be sure to sample plants throughout the field to obtain a representative sample. Calculate the average number of aphids per plant based on the total number of plants sampled. The UW Nutrient and Pest Management program has developed a handy card to help with scouting and counting. *The Visual Guide for Soybean Aphid Scouting* is available at <https://ipcm.wisc.edu/sba2010-web/>
- Continue monitoring throughout the R5 pod development growth stage as aphids move down stems

and colonies become distributed throughout the canopy.

Regular field visits are critical as populations can increase to economically damaging levels within several days. However, keep in mind that the presence of soybean aphids does not mean that populations will necessarily reach damaging levels. A number of factors play a role in regulating populations: natural enemies (predators and parasitic wasps), temperature (aphids reproduce fastest between 68 and 77°F), planting date, aphid fungal disease, soybean growth stage, degree of plant stress (e.g., drought), and possibly, soybean variety. Regular scouting will help determine how these factors are influencing aphid growth rates under certain field conditions. Monitor soybean aphids through the R5 growth stage.

- **Treat when approximately 80% of the field has reached an average of 250 aphids per plant AND the population is actively increasing.** University trials have found that the best control and yield response occurs when plants are treated between beginning bloom (R1) and beginning seed (R5). Once pods have reached full seed (R6), it is too late to protect yield and treatment is not recommended. For pictures and descriptions of soybean growth stages, see *Reproductive Soybean Development Stages and Soybean Aphid Thresholds* at [fyi.uwex.edu/fieldcroppathology/files/2010/12/aphid\\_thresholds.pdf](http://fyi.uwex.edu/fieldcroppathology/files/2010/12/aphid_thresholds.pdf)

Research and scouting updates are posted regularly during the growing season in the Wisconsin Crop Manager newsletter ([ipcm.wisc.edu/wcm](http://ipcm.wisc.edu/wcm)). For more information about regional aphid population developments, contact your county Extension agent. Another valuable source of information is the Wisconsin's Department of Agriculture, Trade and Consumer's Protection's Wisconsin Pest Survey Bulletin. A free electronic subscrip-

tion may be obtained at <http://datcp-services.wisconsin.gov/pb/subscribe.jsp>

**Insecticide application methods.** Proper insecticide spraying methods often are more important than the selection of a particular insecticide for control of soybean aphid because most labeled foliar products are very effective.

**Insecticide Resistance.** Resistance has been found to some of the synthetic pyrethroid insecticides in surrounding states. The best resistance management practice is to spray at threshold populations and only if the population is increasing and beneficial insects are not making an impact on the overall soybean aphid population. Change insecticide mode of action if a second application is needed.

**To optimize foliar coverage, growers should increase pressure (40 psi), increase carrier (20 gpa of water), and use small droplet-size nozzles.**

Complete coverage is important for optimum aphid control because soybean aphids feed on the undersides of leaves. Soybean aphid research indicates that aerial and ground applications of foliar-applied insecticides provides comparable efficacy of soybean aphid control, as long as pressure, carrier volume, and droplet size are optimized (source: *Management Recommendations for Soybean Aphid in the United States*. Hodgson, E.W. et al. DOI: [dx.doi.org/10.1603/IPM11019](https://doi.org/10.1603/IPM11019)).

## Stink bugs

Two species of stink bugs—the green stink bug (*Acrosternum hilare*) and the brown stink bug (*Euschistus* spp.)—may be found in Wisconsin soybean fields in August. A third species, the Brown Marmorated Stink Bug, has recently been detected in Wisconsin. Although Brown Marmorated Stink Bugs have not been a pest on soybeans in Wisconsin they have been an economic pest in other states. Stink bugs feed in clusters on plants along

**Table 3-7.** Treatment decision guidelines for two-spotted spider mites

Presence of mites	Damage	Assessment
Barely detected on leaves in dry locations or on edges of fields.	Barely detectable.	Treatment not necessary.
Easily detected on leaves in dry locations or on edges of fields. Difficult to find within field.	Foliage is green, but stippling injury is detectable on undersides of leaves of some plants.	Treatment not necessary but keep monitoring.
All plants are infested.	All plants exhibit some stippling, even on healthy leaves. Some speckling and discoloration of lower leaves. Field margins and dry areas have most damage.	Rescue treatment is warranted, especially if many immatures and eggs are present.
All plants heavily infested.	Discolored and wilted leaves easily found throughout the field. Severe damage evident.	Effective rescue treatment may save field.
Extremely high numbers present.	Field discolored, leaves drying down. Significant foliage and stand loss.	Rescue treatment may not save field. However, new growth may appear if treated.

Source: Excerpted from Ohio State University and Michigan State University

field edges, becoming quite noticeable as plant leaves turn yellow. Occasionally populations may be high.

Color is the chief distinction between the two species. Stink bug adults have a shield-shaped body, with pointed “shoulders.” Green stink bug adults are bright green with black bands on their antennae; adult brown stink bugs are speckled brown. Nymphs are rounder than adults, roughly resembling a beetle. Green stink bug nymphs are multicolored (black, green, yellow, and red markings), while brown stink bug nymphs are copper-brown.

Both nymphs and adults have piercing-sucking mouthparts that they use to penetrate the pod and suck plant fluids. Punctures can be found as small brown or black spots. Young seeds may be deformed, undersized, and possibly aborted under heavy stink bug pressure; older seeds can be discolored or shriveled. Feeding damage may also indirectly delay plant maturity.

In early August, as soybean pods begin to fill, scout five different areas of the field taking 20 samples at each location. Use sweep nets for drilled narrow-row beans. For wide-row plantings, place a light-colored cloth between rows and shake plants

to dislodge bugs from the canopy. Count both nymphs and adults in the sample total. Calculate stink bugs per sweep (or per row foot) based on the average of all samples taken throughout the field.

Stink bug thresholds in seed beans are lower than in grain soybean. In wide-row plantings, thresholds range from 1-3 bugs/foot of row. For narrow-row plantings, the threshold is 20 bugs/100 sweeps for seed beans and 40 bugs/100 sweeps for grain soybean.

### Thistle caterpillar (painted lady butterfly)

The painted lady, an orange and brown mottled butterfly, is noted for periods of great abundance followed by periods of great scarcity, probably due to natural control. It is strongly migratory, explaining its appearance in northern areas such as Wisconsin. The butterfly causes no damage to cultivated crops.

The larval stage, called the thistle caterpillar, is usually first noticed feeding on thistles. Subsequent generations occurring in late July and August can be found in soybean in large enough numbers to cause concern. The spiny caterpillars have a mottled yellow-

ish-green and black body with a yellow stripe running the length. The spines are also yellowish.

Thistle caterpillars form a loose silk webbing in the upper three or four leaves where they feed. The black granular-appearing material found in the webbing is fecal matter (frass). Most defoliation occurs during the last two stages of larval development when larvae are  $\frac{3}{4}$  to 1- $\frac{1}{4}$  inches long. During the reproductive stages, soybean can withstand 20% defoliation without an economic loss in yield. In the vegetative stage (pre-bloom), plants can withstand up to 30% defoliation before the yield loss is economically damaging.

### Two-spotted spider mite

Two-spotted spider mites can become serious during hot dry weather. Adults are tiny (less than  $\frac{1}{16}$  inch), yellow-green with eight legs and dark spots on either side of their oval bodies. Magnification (a 10X hand lens) is often necessary to clearly see spider mite adults, nymphs, and eggs. Eggs are round, white to light yellow, and laid on the underside of leaves. In northern states, populations overwinter as adult females in sheltered field margin areas. In most years, adequate rainfall and a fungal pathogen keep

the spider mites in check. During outbreaks, however, spider mites reproduce quickly with multiple overlapping generations. Eggs hatch in 2-4 days, nymphs develop in 2-4 days, and adults can live up to 21 days. Each generation is completed in 4-14 days, with the fastest developmental rates occurring when temperatures exceed 91°F.

Spider mites damage plants by piercing the cells and sucking sap. Mites often go undetected until damage is severe in part because of their tiny size and because plants are drought-stressed. Initially, leaves are discolored with tiny white or yellow specks (stippling). Leaves turn from yellow to bronze and may fall off under heavy infestations. Webbing is often found on the undersides of leaves. Damage is often more severe along field edges where mites have migrated from adjacent fields, grasses, weeds, or in drier areas of the field.

Check the upper, middle, and lower canopy for damage as well as for the presence of live mites and webbing on the undersides of leaves. Estimate the percentage of soybean leaf surface damage (stippling, discoloration). Tap plants onto a white sheet of paper to dislodge mites from the plant. If present, you will see black specks moving slowly on the surface. If an injury is evident within the field, there is a potential for economically damaging populations within 1-2 weeks. Monitor the entire field to determine whether spot treatment or whole field treatment is appropriate.

No specific economic threshold has been developed for two-spotted spider mite in soybean. Treatment may be warranted if:

- Mites are present between bloom (R1) and pod fill (R5);
- 15% or more leaf area on plants are discolored and stippled with leaves yellowing;
- Live mites are present; and
- Hot, dry weather is expected to continue.

Refer to table 3-7 for treatment decision guidelines for the Upper Midwest soybean growing region.

Treatment may be delayed if cooler temperatures and high humidity are expected. Although rainfall reduces the risk of damaging spider mite populations, thunderstorms alone cannot be relied upon to eliminate infestations, particularly if rains arrive after the establishment of large mite populations and are followed by continued hot, dry conditions.

The most effective natural enemy of the two-spotted spider mite is a fungal pathogen that thrives under relatively cool temperatures (less than 85°F) with at least 90% relative humidity. At least 12-4 hours of such conditions are believed necessary for extensive spread of the disease, and spider mite populations may decline rapidly in response to fungal disease activity. Infected mites have a dark discolored, waxy, or cloudy appearance, and mite death occurs within 1-3 days of infection.

## Insecticide suggestions for soybean pests

### Bean leaf beetle

**Threshold:** Consult tables 3.5, 3.6a, and 3.6b for thresholds

#### Acephate 90 Prill

**Rate:** 0.83 -1.1 lbs/a

**Active ingredient:** acephate

**IRAC code:** 1B

**Preharvest interval (days):** 14; Do not graze or cut vines for hay or forage.

**Maximum rate:** Do not apply more than 1.66 lbs/a/season

#### Alias 4F

**Rate:** 1.5 fl oz/a

**Active ingredient:** imidacloprid

**IRAC code:** 4A

**Preharvest interval (days):** 21

**Maximum rate:** 4.5 fl oz/a (0.14 lb ai/a)/year

*Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.*

#### Asana XL

**Rate:** 5.8-9.6 fl oz

**Active ingredient:** esfenvalerate

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.2 lb ai/a/season

*Do not feed or graze livestock on treated fields.*

#### Baythroid XL

**Rate:** 0.8-1.6 fl oz

**Active ingredient:** beta-cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21 for grain, 15 days for hay and green forage

**Maximum rate:** 11.2 fl oz/a/season

#### Belay

**Rate:** 3.0-6.0 fl oz

**Active ingredient:** clothianidin

**IRAC code:** 4A

**Preharvest interval (days):** 21 for grain. Do not graze or feed soybean forage and hay to livestock

**Maximum rate:** 0.2 lb ai/a/season

*Do not make foliar applications in fields treated with a neonicotinoid insecticide seed treatment within 45 days after planting. Do not graze or feed soybean forage and hay to livestock. Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.*

#### Besiege

**Rate:** 5.0-8.0 fl oz

**Active ingredient:** lambda-cyhalothrin, chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 30

**Maximum rate:** 20.0 fl oz Besiege or 0.06 lb ai of lambda-cyhalothrin-containing products or 0.2 lb ai of chlorantraniliprole-containing products/a/year

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed. Application restriction exist for this product because of risk to bees and other insect pollinators.*

#### Brigade 2EC

**Rate:** 2.1-6.4 fl oz

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 18

**Maximum rate:** 0.3 lb ai/a/season

### Cruiser 5FS

**Rate:** 1.28 fl oz/100 lb seed

**Active ingredient:** thiamethoxam

**IRAC code:** 4A

**Maximum rate:** 37.8 g ai/a/season

*Do not apply a neonicotinoid insecticide within 45 days of planting seed treated with Cruiser 5FS.*

### Declare 1.25CS

**Rate:** 0.77-1.28 fl oz/a

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 45

**Maximum rate:** 0.19 pt/a (0.03 lb ai/a)/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

### Delta Gold 1.5EC

**Rate:** 1.5-2.4 fl oz

**Active ingredient:** deltamethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 8.5 fl oz/a (0.1 lb ai/a)/season

*Do not allow livestock to graze treated forage or feed treated hay to livestock.*

### Dimethoate (several)

**Rate:** See label (rate varies by formulation)

**Active ingredient:** dimethoate

**IRAC code:** 1B

**Preharvest interval (days):** Consult label

**Maximum rate:** Consult label

### Elevest

**Rate:** 4.8-9.6 fl oz

**Active ingredient:** bifenthrin, chlorantraniliprole

**IRAC code:** 3A28

**Preharvest interval (days):** 18

**Maximum rate:** 0.2 lb ai of chlorantraniliprole-containing products and 0.3 lb ai of bifenthrin containing compounds /a/year

### Endigo ZC

**Rate:** 4.0-4.5 fl oz

**Active ingredient:** lambda-cyhalothrin, thiamethoxam

**IRAC code:** 3A, 4A

**Preharvest interval (days):** 30

**Maximum rate:** 9.0 fl oz of Endigo ZC or 0.06 lb ai of lambda-cyhalothrin containing products or 0.125 lb ai of foliar applied thiamethoxam containing products/a/season. Application restrictions exist for

this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed. Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.*

### Fanfare EC, ES

**Rate:** 2.1-6.4 fl oz/a

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 18

**Maximum rate:** Do not apply more than 0.3 lb ai /a/season

*Do not make applications less than 30 days apart.*

### Fastac EC, SC

**Rate:** 2.8-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 11.4 fl oz/a/season

*Do not graze or harvested treated soybean forage, straw, or hay for livestock feed.*

### Gaucho 600

**Rate:** 1.6-3.2 fl oz/100 lbs seed

**Active ingredient:** imidacloprid

**IRAC Code:** 4A

**Preharvest interval:** none stated

**Maximum rate:** 0.67 lb ai/a/season

*For control of overwintering bean leaf beetle populations*

*Do not graze or feed livestock on soybean forage or hay*

### Hero

**Rate:** 2.6-6.1 fl oz

**Active ingredient:** zeta-cypermethrin, bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 41.2 oz or 0.40 lb ai/a/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

### Leverage 360

**Rate:** 2.8 fl oz

**Active ingredient:** cyfluthrin, imidacloprid

**IRAC code:** 3A, 4A

**Preharvest interval (days):** 21 for seed, 15 for hay and green forage

**Maximum rate:** 9.0 fl oz/a (0.07 lb ai/a beta-cyfluthrin + 0.14 lb ai/a imidacloprid)/season. Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.

### Mustang Maxx

**Rate:** 2.8-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 24 oz/a (0.15 lb ai/a)/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

### NipsIt INSIDE

**Rate:** 1.28 fl oz/100 lb seed

**Active ingredient:** clothianidin

**IRAC code:** 4A

**Preharvest interval (days):** none stated

**Maximum rate:** 0.20 lb ai/a/season, regardless of type of application (seed treatment or foliar)

*Do not graze or feed soybean forage and hay to livestock.*

### Silencer

**Rate:** 1.92-3.2 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

**Maximum rate:** Do not apply more than 0.06 lb ai (0.48 pt)/season

### Skyraider

**Rate:** 2.1-6.0 fl oz/a

**Active ingredient:** bifenthrin, imidacloprid

**IRAC code:** 3A, 4A

**Preharvest interval (days):** 21

**Maximum rate:** Do not apply more 18 fl oz/a of Skyraider/year. Do not apply more than 0.14 lb ai/a of imidacloprid/year. Do not apply more than 0.3 lb ai/a of bifenthrin/year. Do not apply at intervals less than 30 days. Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.

### Warrior II

**Rate:** 0.96-1.60 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 30

**Maximum rate:** 3.84 fl oz/a or 0.24 pt/a

(0.06 lb ai/a)/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

## Cutworm

**Threshold:** None established

### Asana XL

**Rate:** 5.8-9.6 fl oz

**Active ingredient:** esfenvalerate

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.2 lb ai/a/season

*Do not feed or graze livestock on treated fields.*

### Baythroid XL

**Rate:** 0.8-1.6 fl oz

**Active ingredient:** beta-cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21 for grain, 15 days for hay and green forage

**Maximum rate:** 11.2 fl oz/a/season

### Belt 4SC

**Rate:** 2.0-3.0 fl oz/a

**Active ingredient:** flubendiamide

**IRAC code:** 28

**Preharvest interval (days):** 14 for seed, 3 for forage and hay

**Maximum rate:** 6.0 fl oz/a/year

### Besiege

**Rate:** 5.0-8.0 fl oz

**Active ingredient:** lambda-cyhalothrin, chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 30

**Maximum rate:** 20.0 fl oz Besiege or 0.06 lb ai of lambda-cyhalothrin-containing products or 0.2 lb ai of chlorantraniliprole-containing products/a/year

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed. Application restriction exist for this product because of risk to bees and other insect pollinators.*

### Brigade 2EC

**Rate:** 2.1-6.4 fl oz

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 18

**Maximum rate:** 0.3 lb ai/a/season

### Declare 1.25CS

**Rate:** 0.77-1.28 fl oz/a

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 45

**Maximum rate:** 0.19 pt/a (0.03 lb ai/a)/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

### Delta Gold 1.5EC

**Rate:** 1.0-1.5 fl oz

**Active ingredient:** deltamethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 8.5 fl oz/a (0.1 lb ai/a)/season

*Do not allow livestock to graze treated forage or feed treated hay to livestock.*

### Elevest

**Rate:** 4.8-9.6 fl oz

**Active ingredient:** bifenthrin, chlorantraniliprole

**IRAC code:** 3A28

**Preharvest interval (days):** 18

**Maximum rate:** 0.2 lb ai of chlorantraniliprole-containing products and 0.3 lb ai of bifenthrin containing compounds /a/year

### Endigo ZC

**Rate:** 3.5-4.0 fl oz

**Active ingredient:** lambda-cyhalothrin, thiamethoxam

**IRAC code:** 3A, 4A

**Preharvest interval (days):** 30

**Maximum rate:** 9.0 fl oz of Endigo ZC or 0.06 lb ai of lambda-cyhalothrin containing products or 0.125 lb ai of foliar applied thiamethoxam containing products/a/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed. Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.*

### Fanfare EC and ES

**Rate:** 2.1-6.4 fl oz/a

**Active ingredient:** bifenthrin

**IRAC code:** 3

**Preharvest interval (days):** 18

**Maximum rate:** Do not apply more than 0.3 lb ai /a/season. Do not make applications less than 30 days apart.

### Fastac EC, SC

**Rate:** 1.3-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 11.4 fl oz/a/season

*Do not graze or harvested treated soybean forage, straw, or hay for livestock feed.*

### Hero

**Rate:** 2.6-6.1 fl oz

**Active ingredient:** zeta-cypermethrin, bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 41.2 oz or 0.40 lb ai/a/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

### Leverage 360

**Rate:** 2.8 fl oz

**Active ingredient:** cyfluthrin, imidacloprid

**IRAC code:** 3A, 4A

**Preharvest interval (days):** 21 for seed, 15 for hay and green forage

**Maximum rate:** 9.0 fl oz/a (0.07 lb ai/a beta-cyfluthrin + 0.14 lb ai/a imidacloprid)/season

*Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.*

### Mustang Maxx

**Rate:** 1.28-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 24 oz/a (0.15 lb ai/a)/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

### Silencer

**Rate:** 1.92-3.2 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

**Maximum rate:** Do not apply more than 0.06 lb ai (0.48 pt)/season

### Skyraider

**Rate:** 2.1-6.0 fl oz/a

**Active ingredient:** bifenthrin, imidacloprid

**IRAC code:** 3A, 4A

**Preharvest interval (days):** 21

**Maximum rate:** Do not apply more 18 fl oz/a of Skyraider/year. Do not apply more than 0.14 lb ai/a

of imidacloprid/year. Do not apply more than 0.3 lb ai/a of bifenthrin/year. Do not apply at intervals less than 30 days. Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.

### Vantacor

**Rate:** 1.2-2.5 fl oz  
**Active ingredient:** chlorantraniliprole  
**IRAC code:** 28  
**Preharvest interval (days):** 1  
**Maximum rate:** 0.2 lb ai of chlorantraniliprole containing products/a/year

### Warrior II

**Rate:** 0.96-1.60 fl oz  
**Active ingredient:** lambda-cyhalothrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 30  
**Maximum rate:** 3.84 fl oz/a or 0.24 pt/a (0.06 lb ai/a)/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

### Grasshopper

**Threshold:** Treat when migration from adjacent areas begins, and populations are heavy (more than 30% defoliation before bloom or 20% between bloom and pod fill).

### Acephate 90 Prill

**Rate:** 0.28 -0.56 lbs/a  
**Active ingredient:** acephate  
**IRAC code:** 1B  
**Preharvest interval (days):** 14; Do not graze or cut vines for hay or forage.  
**Maximum rate:** Do not apply more than 1.66 lb/a/season.

### Asana XL

**Rate:** 5.8-9.6 fl oz  
**Active ingredient:** esfenvalerate  
**IRAC code:** 3A  
**Preharvest interval (days):** 21  
**Maximum rate:** 0.2 lb ai/a/season  
*Do not feed or graze livestock on treated fields.*

### Baythroid XL

**Rate:** 2.0-2.8 fl oz  
**Active ingredient:** beta-cyfluthrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 21 for grain, 15 days for hay and green forage  
**Maximum rate:** 11.2 fl oz/a/season

### Besiege

**Rate:** 8.0-10.0 fl oz  
**Active ingredient:** lambda-cyhalothrin, chlorantraniliprole  
**IRAC code:** 3A, 28  
**Preharvest interval (days):** 30  
**Maximum rate:** 20.0 fl oz Besiege or 0.06 lb ai of lambda-cyhalothrin-containing products or 0.2 lb ai of chlorantraniliprole-containing products/a/year

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed. Application restriction exist for this product because of risk to bees and other insect pollinators.*

### Brigade 2EC

**Rate:** 2.1-6.4 fl oz  
**Active ingredient:** bifenthrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 18  
**Maximum rate:** 0.3 lb ai/a/season

### Coragen

**Rate:** 2.0-5.0 fl oz  
**Active ingredient:** chlorantraniliprole  
**IRAC code:** 28  
**Preharvest interval (days):** 1  
**Maximum rate:** 0.2 lb ai of chlorantraniliprole-containing products/a/year

### Declare 1.25CS

**Rate:** 1.28-1.54 fl oz/a  
**Active ingredient:** gamma-cyhalothrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 45  
**Maximum rate:** 0.19 pt/a (0.03 lb ai/a)/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

### Delta Gold 1.5EC

**Rate:** 1.5-2.4 fl oz  
**Active ingredient:** deltamethrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 21  
**Maximum rate:** 8.5 fl oz/a (0.1 lb ai/a)/season

*Do not allow livestock to graze treated forage or feed treated hay to livestock.*

### Dimethoate (several)

**Rate:** See label (rate varies by formulation).  
**Active ingredient:** dimethoate  
**IRAC code:** 1B  
**Preharvest interval (days):** Consult label  
**Maximum rate:** Consult label

### Elevest

**Rate:** 4.8-9.6 fl oz  
**Active ingredient:** bifenthrin, chlorantraniliprole  
**IRAC code:** 3A28  
**Preharvest interval (days):** 18  
**Maximum rate:** 0.2 lb ai of chlorantraniliprole-containing products and 0.3 lb ai of bifenthrin containing compounds /a/year

### Endigo ZC

**Rate:** 4.0-4.5 fl oz  
**Active ingredient:** lambda-cyhalothrin, thiamethoxam  
**IRAC code:** 3A, 4A  
**Preharvest interval (days):** 30  
**Maximum rate:** 9.0 fl oz of Endigo ZC or 0.06 lb ai of lambda-cyhalothrin containing products or 0.125 lb ai of foliar applied thiamethoxam containing products/a/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed. Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.*

### Fanfare EC, ES

**Rate:** 2.1-6.4 fl oz/a  
**Active ingredient:** bifenthrin  
**IRAC code:** 3  
**Preharvest interval (days):** 18  
**Maximum rate:** Do not apply more than 0.3 lb ai /a/season

*Do not make applications less than 30 days apart.*

### Fastac EC, SC

**Rate:** 3.2-3.8 fl oz  
**Active ingredient:** alpha-cypermethrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 21  
**Maximum rate:** 11.4 fl oz/a/season

*Do not graze or harvested treated soybean forage, straw, or hay for livestock feed.*

### Hero

**Rate:** 2.6-6.1 fl oz  
**Active ingredient:** zeta-cypermethrin, bifenthrin  
**IRAC code:** 3A  
**Preharvest interval (days):** 21  
**Maximum rate:** 41.2 oz or 0.40 lb ai/a/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

## Leverage 360

**Rate:** 2.8 fl oz

**Active ingredient:** cyfluthrin, imidacloprid

**IRAC code:** 3A, 4A

**Preharvest interval (days):** 21 for seed, 15 for hay and green forage

**Maximum rate:** 9.0 fl oz/a (0.07 lb ai/a beta-cyfluthrin + 0.14 lb ai/a imidacloprid)/season

*Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.*

## Mustang Maxx

**Rate:** 3.2-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 24 oz/a (0.15 lb ai/a)/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

## Silencer

**Rate:** 3.2-3.84 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

**Maximum rate:** Do not apply more than 0.06 lb ai (0.48 pt)/season

## Skyraider

**Rate:** 2.1-6.0 fl oz/a

**Active ingredient:** bifenthrin, imidacloprid,

**IRAC code:** 3A, 4A

**Preharvest interval (days):** 21,

**Maximum rate:** Do not apply more 18 fl oz/a of Skyraider/year. Do not apply more than 0.14 lb ai/a of imidacloprid/year. Do not apply more than 0.3 lb ai/a of bifenthrin/year. Do not apply at intervals less than 30 days. Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.

## Vantacor

**Rate:** 0.7-1.7 fl oz

**Active ingredient:** chlorantraniliprole

**IRAC code:** 28

**Preharvest interval (days):** 1

**Maximum rate:** 0.2 lb ai of chlorantraniliprole-containing products/a/year

## Warrior II

**Rate:** 1.60-1.92 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 30

**Maximum rate:** 3.84 fl oz/a or 0.24 pt/a (0.06 lb ai/a)/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

## Green cloverworm

**Threshold:** Usually requires 12 or more half-grown worms per foot of row and 15% defoliation during pod set and pod fill stages.

## Acephate 90 Prill

**Rate:** 0.83 -1.1 lb/a

**Active ingredient:** acephate

**IRAC code:** 1B

**Preharvest interval (days):** 14; Do not graze or cut vines for hay or forage.

**Maximum rate:** Do not apply more than 1.66 lb/a/season

## Asana XL

**Rate:** 2.9-5.8 fl oz

**Active ingredient:** esfenvalerate

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.2 lb ai/a/season

*Do not feed or graze livestock on treated fields.*

## Baythroid XL

**Rate:** 0.8-1.6 fl oz

**Active ingredient:** beta-cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21 for grain, 15 days for hay and green forage

**Maximum rate:** 11.2 fl oz/a/season

## Belt 4SC

**Rate:** 2.0-3.0 fl oz/a

**Active ingredient:** flubendiamide

**IRAC code:** 28

**Preharvest interval (days):** 14 for seed, 3 for forage and hay

**Maximum rate:** 6.0 fl oz/a/year

## Besiege

**Rate:** 5.0-8.0 fl oz

**Active ingredient:** lambda-cyhalothrin, chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 30

**Maximum rate:** 20.0 fl oz Besiege or 0.06 lb ai of

lambda-cyhalothrin-containing products or 0.2 lb ai of chlorantraniliprole-containing products/a/year

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed. Application restriction exist for this product because of risk to bees and other insect pollinators.*

## Brigade 2EC

**Rate:** 2.1-6.4 fl oz

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 18

**Maximum rate:** 0.3 lb ai/a/season

## Coragen

**Rate:** 3.5-7.5 fl oz

**Active ingredient:** chlorantraniliprole

**IRAC code:** 28

**Preharvest interval (days):** 1

**Maximum rate:** 0.2 lb ai of chlorantraniliprole-containing products/a/year

## Declare 1.25CS

**Rate:** 0.77-1.28 fl oz/a

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 45

**Maximum rate:** 0.19 pt/a (0.03 lb ai/a)/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

## Delta Gold 1.5EC

**Rate:** 1.0-1.5 fl oz

**Active ingredient:** deltamethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 8.5 fl oz/a (0.1 lb ai/a)/season

*Do not allow livestock to graze treated forage or feed treated hay to livestock.*

## Elevest

**Rate:** 4.8-9.6 fl oz

**Active ingredient:** bifenthrin, chlorantraniliprole

**IRAC code:** 3A28

**Preharvest interval (days):** 18

**Maximum rate:** 0.2 lb ai of chlorantraniliprole-containing products and 0.3 lb ai of bifenthrin containing compounds /a/year

## Endigo ZC

**Rate:** 3.5-4.0 fl oz

**Active ingredient:** lambda-cyhalothrin, thiamethoxam

**IRAC code:** 3A, 4A

**Preharvest interval (days):** 30

**Maximum rate:** 9.0 fl oz of Endigo ZC or 0.06 lb ai of lambda-cyhalothrin containing products or 0.125 lb ai of foliar applied thiamethoxam containing products/a/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed. Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.*

## Fanfare EC, ES

**Rate:** 2.1-6.4 fl oz/a

**Active ingredient:** bifenthrin

**IRAC code:** 3

**Preharvest interval (days):** 18

**Maximum rate:** Do not apply more than 0.3 lb ai/a/season. Do not make applications less than 30 days apart.

## Fastac EC, SC

**Rate:** 2.8-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 11.4 fl oz/a/season

*Do not graze or harvested treated soybean forage, straw, or hay for livestock feed.*

## Hero

**Rate:** 2.6-6.1 fl oz

**Active ingredient:** zeta-cypermethrin, bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 41.2 oz or 0.40 lb ai/a/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

## Intrepid 2F

**Rate:** 4.0-8.0 fl oz

**Active ingredient:** methoxyfenozide

**IRAC code:** 18

**Preharvest interval (days):** 14 for seed, 7 days for hay and forage

**Maximum rate:** 64 fl oz/a (1 lb ai/a)/season

## Intrepid Edge

**Rate:** 4-6.4 fl oz/a

**Active ingredient:** methoxyfenozide, spinetoram

**IRAC code:** 5, 18

**Preharvest interval (days):** 28 days of seed harvest

**Maximum rate:** 25.6 fl oz/acre/season

## Leverage 360

**Rate:** 2.8 fl oz

**Active ingredient:** cyfluthrin, imidacloprid

**IRAC code:** 3A, 4A

**Preharvest interval (days):** 21 for seed, 15 for hay and green forage

**Maximum rate:** 9.0 fl oz/a (0.07 lb ai/a beta-cyfluthrin + 0.14 lb ai/a imidacloprid)/season

Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.

## Mustang Maxx

**Rate:** 2.8-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 24 oz/a (0.15 lb ai/a)/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

## Silencer

**Rate:** 1.92-3.2 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

**Maximum rate:** Do not apply more than 0.06 lb ai (0.48 pt)/season

## Skyraider

**Rate:** 2.1-6.0 fl oz/a

**Active ingredient:** bifenthrin, imidacloprid

**IRAC code:** 3A, 4A

**Preharvest interval (days):** 21

**Maximum rate:** Do not apply more 18 fl oz/a of Skyraider/year. Do not apply more than 0.14 lb ai/a of imidacloprid/year. Do not apply more than 0.3 lb ai/a of bifenthrin/year. Do not apply at intervals less than 30 days. Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.

## Steward

**Rate:** 4.6-11.3 fl oz

**Active ingredient:** indoxacarb

**IRAC code:** 22

**Preharvest interval (days):** 21

**Maximum rate:** 0.44 lb ai/a/season, make no more than 4 applications/crop

## Tracer

**Rate:** 1.0-2.0 fl oz

**Active ingredient:** spinosad

**IRAC code:** 5

**Preharvest interval (days):** 28

**Maximum rate:** 6.0 fl oz/a (0.188 lb ai/a)/a/year

*Do not feed treated forage or hay to meat or dairy animals.*

## Vantacor

**Rate:** 1.2-2.5 fl oz

**Active ingredient:** chlorantraniliprole

**IRAC code:** 28

**Preharvest interval (days):** 1

**Maximum rate:** 0.2 lb ai of chlorantraniliprole-containing products/a/year

## Warrior II

**Rate:** 0.96-1.60 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 30

**Maximum rate:** 3.84 fl oz/a or 0.24 pt/a (0.06 lb ai/a)/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

## Japanese beetle (adult)

**Threshold:** 30% leaf defoliation before bloom and 20% defoliation between bloom and pod fill.

## Alias 4F

**Rate:** 1.5 fl oz/a

**Active ingredient:** imidacloprid

**IRAC code:** 4A

**Preharvest interval (days):** 21

**Maximum rate:** 4.5 fl oz/a (0.14 lb ai/a)/year

Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.

## Asana XL

**Rate:** 5.8-9.6 fl oz

**Active ingredient:** esfenvalerate

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.2 lb ai/a/season

*Do not feed or graze livestock on treated fields.*

## Baythroid XL

**Rate:** 1.6-2.8 fl oz

**Active ingredient:** beta-cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21 for grain, 15 days for hay and green forage

**Maximum rate:** 11.2 fl oz/a/season

## Belay

**Rate:** 3.0–6.0 fl oz

**Active ingredient:** clothianidin

**IRAC code:** 4A

**Preharvest interval (days):** 21 for grain. Do not graze or feed soybean forage and hay to livestock

**Maximum rate:** 0.2 lb ai/a/season; Do not make foliar applications in fields treated with a neonicotinoid insecticide seed treatment within 45 days after planting. Do not graze or feed soybean forage and hay to livestock. Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.

## Besiege

**Rate:** 8.0–10.0 fl oz

**Active ingredient:** lambda-cyhalothrin, chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 30

**Maximum rate:** 20.0 fl oz Besiege or 0.06 lb ai of lambda-cyhalothrin-containing products or 0.2 lb ai of chlorantraniliprole-containing products/a/year

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed. Application restriction exist for this product because of risk to bees and other insect pollinators.*

## Brigade 2EC

**Rate:** 2.1–6.4 fl oz

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 18

**Maximum rate:** 0.3 lb ai/a/season

## Declare 1.25CS

**Rate:** 1.28–1.54 fl oz/a

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 45

**Maximum rate:** 0.19 pt/a (0.03 lb ai/a)/season  
Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

## Delta Gold 1.5EC

**Rate:** 1.5–2.4 fl oz

**Active ingredient:** deltamethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 8.5 fl oz/a (0.1 lb ai/a)/season

*Do not allow livestock to graze treated forage or feed treated hay to livestock.*

## Elevest

**Rate:** 4.8–9.6 fl oz

**Active ingredient:** bifenthrin, chlorantraniliprole

**IRAC code:** 3A28

**Preharvest interval (days):** 18

**Maximum rate:** 0.2 lb ai of chlorantraniliprole-containing products and 0.3 lb ai of bifenthrin containing compounds /a/year

## Endigo ZC

**Rate:** 4.0–4.5 fl oz

**Active ingredient:** lambda-cyhalothrin, thiamethoxam

**IRAC code:** 3A, 4A

**Preharvest interval (days):** 30

**Maximum rate:** 9.0 fl oz of Endigo ZC or 0.06 lb ai of lambda-cyhalothrin containing products or 0.125 lb ai of foliar applied thiamethoxam containing products/a/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed. Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.*

## Fanfare EC, ES

**Rate:** 2.1–6.4 fl oz/a

**Active ingredient:** bifenthrin

**IRAC code:** 3

**Preharvest interval (days):** 18

**Maximum rate:** Do not apply more than 0.3 lb ai /a/season. Do not make applications less than 30 days apart.

## Fastac EC, SC

**Rate:** 2.8–3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 11.4 fl oz/a/season

*Do not graze or harvested treated soybean forage, straw, or hay for livestock feed.*

## Hero

**Rate:** 4.0–10.3 fl oz

**Active ingredient:** zeta-cypermethrin, bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 41.2 oz or 0.40 lb ai/a/season

*Do not graze or harvest treated soybean forage,*

*straw, or hay for livestock feed.*

## Leverage 360

**Rate:** 2.8 fl oz

**Active ingredient:** cyfluthrin, imidacloprid

**IRAC code:** 3A, 4A

**Preharvest interval (days):** 21 for seed, 15 for hay and green forage

**Maximum rate:** 9.0 fl oz/a (0.07 lb ai/a beta-cyfluthrin + 0.14 lb ai/a imidacloprid)/season

Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.

## Mustang Maxx

**Rate:** 2.8–4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 24 oz/a (0.15 lb ai/a)/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

## Silencer

**Rate:** 3.2–3.84 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

**Maximum rate:** Do not apply more than 0.06 lb ai (0.48 pt)/season

## Skyraider

**Rate:** 2.1–6.0 fl oz/a

**Active ingredient:** bifenthrin, imidacloprid

**IRAC code:** 3A, 4A

**Preharvest interval (days):** 21

**Maximum rate:** Do not apply more 18 fl oz/a of Skyraider/year. Do not apply more than 0.14 lb ai/a of imidacloprid/year. Do not apply more than 0.3 lb ai/a of bifenthrin/year. Do not apply at intervals less than 30 days. Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.

## Warrior II

**Rate:** 1.60–1.92 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Active ingredient:** lambda-cyhalothrin

**Maximum rate:** 3.84 fl oz/a or 0.24 pt/a (0.06 lb ai/a)/season

*Do not graze or harvest treated soybean forage,*

straw, or hay for livestock feed.

## Seedcorn maggot

**Threshold:** None established

### Cruiser 5FS, Cruiser Maxx, Cruiser Maxx Plus

**Rate:** consult individual label

**Active ingredient:** thiamethoxam

**IRAC code:** 4A

**Maximum rate:** consult individual label

*Do not apply a neonicotinoid insecticide within 45 days of planting seed treated with Cruiser 5FS.*

### Gaucha 600

**Rate:** 1.6–3.2 fl oz/100 lbs seed

**Active ingredient:** imidacloprid

**IRAC Code:** 4A

**Preharvest interval (days):** none stated

**Maximum rate:** 0.67 lb ai/a/season

*Do not graze or feed livestock on soybean forage or hay.*

### NipsIt INSIDE

**Rate:** 1.28 fl oz/100 lb seed

**Active ingredient:** clothianidin

**IRAC code:** 4A

**Preharvest interval (days):** none stated

**Maximum rate:** 0.20 lb ai/a/season, regardless of type of application (seed treatment or foliar)

*Do not graze or feed soybean forage and hay to livestock.*

## Soybean aphid

**Threshold:** 250 aphids per plant over 80% of the field and populations are increasing during crop stages R1 through R5.

### Acephate 90 Prill

**Rate:** 0.83–1.1 lbs/a

**Active ingredient:** acephate

**IRAC code:** 1B

**Preharvest interval (days):** 14; Do not graze or cut vines for hay or forage.

**Maximum rate:** Do not apply more than 1.66 lb/a/season

### Alias 4F

**Rate:** 1.5 fl oz/a

**Active ingredient:** imidacloprid

**IRAC code:** 4A

**Preharvest interval (days):** 21

**Maximum rate:** 4.5 fl oz/a (0.14 lb ai/a)/year

Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow applications instructions found on the label.

### Asana XL

**Rate:** 5.8–9.6 fl oz

**Active ingredient:** esfenvalerate

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.2 lb ai/a/season

*Do not feed or graze livestock on treated fields.*

### Baythroid XL

**Rate:** 2.0–2.8 fl oz

**Active ingredient:** beta-cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21 for grain, 15 days for hay and green forage

**Maximum rate:** 11.2 fl oz/a/season

### Belay

**Rate:** 3.0–6.0 fl oz

**Active ingredient:** clothianidin

**IRAC code:** 4A

**Preharvest interval (days):** 21 for grain. Do not graze or feed soybean forage and hay to livestock

**Maximum rate:** 0.2 lb ai/a/season

0.2 lb ai/a/season; Do not make foliar applications in fields treated with a neonicotinoid insecticide seed treatment within 45 days after planting. Do not graze or feed soybean forage and hay to livestock. Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow applications instructions found on the label.

*Do not graze or feed soybean forage and hay to livestock.*

### Besiege

**Rate:** 5.0–8.0 fl oz

**Active ingredient:** lambda-cyhalothrin, chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 30

**Maximum rate:** 20.0 fl oz Besiege or 0.06 lb ai of lambda-cyhalothrin-containing products or 0.2 lb ai of chlorantraniliprole-containing products/a/year

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed. Application restriction exist for this product because of risk to bees and other insect pollinators.*

### Brigade 2EC

**Rate:** 2.1–6.4 fl oz

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 18

**Maximum rate:** 0.3 lb ai/a/season

### Declare 1.25CS

**Rate:** 0.77–1.28 fl oz/a

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 45

**Maximum rate:** 0.19 pt/a (0.03 lb ai/a)/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

### Delta Gold 1.5EC

**Rate:** 1.5–2.4 fl oz

**Active ingredient:** deltamethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 8.5 fl oz/a (0.1 lb ai/a)/season

*Do not allow livestock to graze treated forage or feed treated hay to livestock.*

### Dimethoate (several)

**Rate:** See label (rate varies by formulation).

**Active ingredient:** dimethoate

**IRAC code:** 1B

**Preharvest interval (days):** Consult label

**Maximum rate:** Consult label

### Endigo ZC

**Rate:** 3.5–4.0 fl oz

**Active ingredient:** lambda-cyhalothrin, thiamethoxam

**IRAC code:** 3A, 4A

**Preharvest interval (days):** 30

**Maximum rate:** 9.0 fl oz of Endigo ZC or 0.06 lb ai of lambda-cyhalothrin containing products or 0.125 lb ai of foliar applied thiamethoxam containing products/a/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed. Application restrictions exist for this product because of risk to bees and other insect pollinators. Follow applications instructions found on the label.*

### Fanfare EC, ES

**Rate:** 2.1–6.4 fl oz/a

**Active ingredient:** bifenthrin

**IRAC code:** 3

**Preharvest interval (days):** 18

**Maximum rate:** Do not apply more than 0.3 lb ac-

tive ingredient /a/season. Do not make applications less than 30 days apart.

## Fastac EC, SC

**Rate:** 2.8-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 11.4 fl oz/a/season

*Do not graze or harvested treated soybean forage, straw, or hay for livestock feed.*

## Hero

**Rate:** 4.0-10.3 fl oz

**Active ingredient:** zeta-cypermethrin, bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 41.2 oz or 0.40 lb ai/a/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

## Leverage 360

**Rate:** 2.8 fl oz

**Active ingredient:** cyfluthrin, imidacloprid

**IRAC code:** 3A, 4A

**Preharvest interval (days):** 21 for seed, 15 for hay and green forage

**Maximum rate:** 9.0 fl oz/a (0.07 lb ai/a beta-cyfluthrin + 0.14 lb ai/a imidacloprid)/season

*Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.*

## Mustang Maxx

**Rate:** 2.8-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 24 oz/a (0.15 lb ai/a)/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

## Sefina

**Rate:** 3.0 fl oz/a

**Active ingredient:** afidopyropen

**IRAC code:** 9D

**Preharvest interval (days):** 7

**Maximum rate:** 6 fl oz/acre/season

*Do not feed or graze soybean hay or forage*

## Silencer

**Rate:** 1.92-3.2 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

**Maximum rate:** Do not apply more than 0.06 lb ai (0.48 pt)/season

## Skyraider

**Rate:** 2.1-6.0 fl oz/a

**Active ingredient:** bifenthrin, imidacloprid

**IRAC code:** 3A, 4A

**Preharvest interval (days):** 21

**Maximum rate:** Do not apply more than 18 fl oz/a of Skyraider/year. Do not apply more than 0.14 lb ai/a of imidacloprid/year. Do not apply more than 0.3 lb ai/a of bifenthrin/year. Do not apply at intervals less than 30 days. Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.

## Transform WG

**Rate:** 0.75-1.0 oz

**Active ingredient:** sulfoxaflor

**IRAC code:** 4C

**Preharvest interval (days):** 7 for seed, forage or hay harvest

**Maximum rate:** Do not apply more than 8.5 oz of Transform WG (0.266 lb ai of sulfoxaflor) per acre per year

## Warrior II

**Rate:** 0.96-1.60 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 30

**Maximum rate:** 3.84 fl oz/a or 0.24 pt/a (0.06 lb ai/a)/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

## Stink bug

**Threshold:** Treat when adults or nymphs reach 1-3 bugs per foot of row during pod fill, 40 bugs per 100 sweeps for grain soybean, or 20 bugs per 100 sweeps for seed beans.

## Acephate 90 Prill

**Rate:** 0.56 -1.1 lbs/a

**Active ingredient:** acephate

**IRAC code:** 1B

**Preharvest interval (days):** 14; Do not graze or cut vines for hay or forage.

**Maximum rate:** Do not apply more than 1.66 lb/a/season

## Asana XL

**Rate:** 5.8-9.6 fl oz

**Active ingredient:** permethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 0.2 lb ai/a/season

*Do not feed or graze livestock on treated fields.*

## Baythroid XL

**Rate:** 1.6-2.8 fl oz

**Active ingredient:** beta-cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21 for grain, hay, and green forage

**Maximum rate:** 11.2 fl oz/a/season

## Belay

**Rate:** 3.0-6.0 fl oz

**Active ingredient:** clothianidin

**IRAC code:** 4A

**Preharvest interval (days):** 21 for grain. Do not graze or feed soybean forage and hay to livestock

**Maximum rate:** 0.2 lb ai/a/season

*Do not make foliar applications in fields treated with a neonicotinoid insecticide seed treatment within 45 days after planting. 0.2 lb ai/a/season; Do not make foliar applications in fields treated with a neonicotinoid insecticide seed treatment within 45 days after planting. Do not graze or feed soybean forage and hay to livestock. Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.*

*Do not graze or feed soybean forage and hay to livestock.*

## Besiege

**Rate:** 8.0-10.0 fl oz

**Active ingredient:** lambda-cyhalothrin, chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 30

**Maximum rate:** 20.0 fl oz Besiege or 0.06 lb ai of lambda-cyhalothrin-containing products or 0.2 lb ai of chlorantraniliprole-containing products/a/year

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed. Application restriction exist for this product because of risk to bees and other insect pollinators.*

## Brigade 2EC

**Rate:** 2.1-6.4 fl oz

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 18

**Maximum rate:** 0.3 lb ai/a/season

## Declare 1.25CS

**Rate:** 1.28-1.54 fl oz/a

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 45

**Maximum rate:** 0.19 pt/a (0.03 lb ai/a)/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

## Delta Gold 1.5EC

**Rate:** 1.5-2.4 fl oz

**Active ingredient:** deltamethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 8.5 fl oz/a (0.1 lb ai/a)/season

*Do not allow livestock to graze treated forage or feed treated hay to livestock.*

## Elevest

**Rate:** 4.8-9.6 fl oz

**Active ingredient:** bifenthrin, chlorantraniliprole

**IRAC code:** 3A28

**Preharvest interval (days):** 18

**Maximum rate:** 0.2 lb ai of chlorantraniliprole-containing products and 0.3 lb ai of bifenthrin containing compounds /a/year

## Endigo ZC

**Rate:** 4.0-4.5 fl oz

**Active ingredient:** lambda-cyhalothrin, thiamethoxam

**IRAC code:** 3A, 4A

**Preharvest interval (days):** 30

**Maximum rate:** 9.0 fl oz of Endigo ZC or 0.06 lb ai of lambda-cyhalothrin containing products or 0.125 lb ai of foliar applied thiamethoxam containing products/a/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed. Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.*

## Fanfare EC, ES

**Rate:** 2.1-6.4 fl oz/a

**Active ingredient:** bifenthrin

**IRAC code:** 3

**Preharvest interval (days):** 18

**Maximum rate:** Do not apply more than 0.3 lb active ingredient /a/season. Do not make applications less than 30 days apart.

## Fastac EC, SC

**Rate:** 3.2-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 11.4 fl oz/a/season

*Do not graze or harvested treated soybean forage, straw, or hay for livestock feed.*

## Hero

**Rate:** 4.0-10.3 fl oz

**Active ingredient:** zeta-cypermethrin, bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 41.2 oz or 0.40 lb ai/a/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

## Leverage 360

**Rate:** 2.8 fl oz

**Active ingredient:** cyfluthrin, imidacloprid

**IRAC code:** 3A, 4A

**Preharvest interval (days):** 21 for seed, 15 for hay and green forage

**Maximum rate:** 9.0 fl oz/a (0.07 lb ai/a beta-cyfluthrin + 0.14 lb ai/a imidacloprid)/season

*Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.*

## Mustang Maxx

**Rate:** 3.2-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 24 oz/a (0.15 lb ai/a)/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

## Ridgeback

**Rate:** 6.9-13.8 fl oz/a

**Active ingredient:** sulfoxaflor, bifenthrin

**IRAC code:** 4C, 3A

**Preharvest interval (days):** 18

**Maximum rate:** Do not apply more than a total of 41.3 fl oz of Ridgeback per acre per yearSilencer

**Rate:** 3.2-3.84 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

**Maximum rate:** Do not apply more than 0.06 lb ai (0.48 pt)/season.

## Skyraider

**Rate:** 2.1-6.0 fl oz/a

**Active ingredient:** bifenthrin, imidacloprid

**IRAC code:** 3A, 4A

**Preharvest interval (days):** 21

**Maximum rate:** Do not apply more 18 fl oz/a of Skyraider/year. Do not apply more than 0.14 lb ai/a of imidacloprid/year. Do not apply more than 0.3 lb ai/a of bifenthrin/year. Do not apply at intervals less than 30 days. Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.

## Warrior II

**Rate:** 1.60-1.92 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 30

**Maximum rate:** 3.84 fl oz/a or 0.24 pt/a (0.06 lb ai/a)/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

## Thistle caterpillar

**Threshold:** 30% leaf defoliation before bloom and 20% defoliation between bloom and pod fill.

## Belt 45C

**Rate:** 2.0-3.0 fl oz/a

**Active ingredient:** flubendiamide

**IRAC code:** 28

**Preharvest interval (days):** 14 for seed, 3 for forage and hay

**Maximum rate:** 6.0 fl oz/a/year

## Besiege

**Rate:** 5.0-8.0 fl oz

**Active ingredient:** lambda-cyhalothrin, chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 30

**Maximum rate:** 20.0 fl oz Besiege or 0.06 lb ai of lambda-cyhalothrin-containing products or 0.2 lb ai of chlorantraniliprole-containing products/a/year

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed. Application restriction exist for this product because of risk to bees and other insect pollinators.*

## Brigade 2EC

**Rate:** 2.1-6.4 fl oz

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 18

**Maximum rate:** 0.3 lb ai/a/season

## Declare 1.25CS

**Rate:** 0.77-1.28 fl oz/a

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 45

**Maximum rate:** 0.19 pt/a (0.03 lb ai/a)/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

## Elevest

**Rate:** 4.8-9.6 fl oz

**Active ingredient:** bifenthrin, chlorantraniliprole

**IRAC code:** 3A28

**Preharvest interval (days):** 18

**Maximum rate:** 0.2 lb ai of chlorantraniliprole-containing products and 0.3 lb ai of bifenthrin containing compounds /a/year

## Endigo ZC

**Rate:** 3.5-4.0 fl oz

**Active ingredient:** lambda-cyhalothrin, thiamethoxam

**IRAC code:** 3A, 4A

**Preharvest interval (days):** 30

**Maximum rate:** 9.0 fl oz of Endigo ZC or 0.06 lb ai of lambda-cyhalothrin containing products or 0.125 lb ai of foliar applied thiamethoxam containing products/a/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed. Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.*

## Fanfare EC, ES

**Rate:** 2.1-6.4 fl oz/a

**Active ingredient:** bifenthrin

**IRAC code:** 3

**Preharvest interval (days):** 18

**Maximum rate:** Do not apply more than 0.3 lb active ingredient /a/season. Do not make applications less than 30 days apart.

## Fastac EC, SC

**Rate:** 1.3-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 11.4 fl oz/a/season

*Do not graze or harvested treated soybean forage, straw, or hay for livestock feed.*

## Hero

**Rate:** 2.6-6.1 fl oz

**Active ingredient:** zeta-cypermethrin, bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 41.2 oz or 0.40 lb ai/a/season

Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

## Mustang Maxx

**Rate:** 1.28-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 24 oz/a (0.15 lb ai/a)/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

## Silencer

**Rate:** 1.92-3.2 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 30; Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

**Maximum rate:** Do not apply more than 0.06 lb ai (0.48 pt)/season

## Vantacor

**Rate:** 1.2-2.5 fl oz

**Active ingredient:** chlorantraniliprole

**IRAC code:** 28

**Preharvest interval (days):** 1

**Maximum rate:** 0.2 lb ai of chlorantraniliprole-containing products/a/year

## Warrior II

**Rate:** 0.96-1.60 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 30

**Maximum rate:** 3.84 fl oz/a or 0.24 pt/a (0.06 lb ai/a)/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

## Two-spotted spider mite

**Threshold:** Treat when leaf stippling and live mites are present and before leaf discoloration or leaf drop progresses to middle and upper canopy.

## Agri-Mek SC

**Rate:** 1.75-3.5 fl oz/a (non-ionic adjuvant required, see label)

**Active ingredient:** abamectin

**IRAC code:** 6

**Preharvest interval (days):** 28. Do not allow livestock to graze in treated soybean forage, straw or hay as feed for meat or dairy animal. Do not feed treated soybean fodder or silage to meat or dairy animals.

**Maximum rate:** 7.0 fl oz/a/season

## Brigade 2EC

**Rate:** 5.12-6.4 fl oz

**Active ingredient:** bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 18

**Maximum rate:** 0.3 lb ai/a/season

## Dimethoate (several)

**Rate:** See label (rate varies by formulation).

**Active ingredient:** dimethoate

**IRAC code:** 1B

**Preharvest interval (days):** Consult label

**Maximum rate:** Consult label

## Elevest

**Rate:** 7.7-9.6 fl oz

**Active ingredient:** bifenthrin, chlorantraniliprole

**IRAC code:** 3A28

**Preharvest interval (days):** 18

**Maximum rate:** 0.2 lb ai of chlorantraniliprole-containing products and 0.3 lb ai of bifenthrin containing compounds /a/year

## Fanfare EC, ES

**Rate:** 5.12-6.4 fl oz/a

**Active ingredient:** bifenthrin

**IRAC code:** 3

**Preharvest interval (days):** 18

**Maximum rate:** Do not apply more than 0.3 lb ai

/a/season. Do not make applications less than 30 days apart.

---

## Hero

**Rate:** 10.3 fl oz

**Active ingredient:** zeta-cypermethrin, bifenthrin

**IRAC code:** 3A

**Preharvest interval (days):** 21

**Maximum rate:** 41.2 oz or 0.40 lb ai/a/season

*Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.*

---

## Skyraider

**Rate:** 5.12-6.0 fl oz/a

**Active ingredient:** bifenthrin, imidacloprid

**IRAC code:** 3A, 4A

**Preharvest interval (days):** 21

Maximum rate: Do not apply more 18 fl oz/a of Skyraider/year. Do not apply more than 0.14 lb ai/a of imidacloprid/year. Do not apply more than 0.3 lb ai/a of bifenthrin/year. Do not apply at intervals less than 30 days. Application restrictions exist for this product because of risk to bees and other insect pollinations. Follow applications instructions found on the label.

---

## Zeal SC

**Rate:** 2-6 fl oz/a

**Active ingredient:** Extoxazole

**IRAC code:** 10B

**Preharvest interval:** Do not apply after R5, Do not graze treated soybean fields for feed treated forage or hay to livestock

**Maximum rate:** maximum of 1 application/season

*Precaution: Zeal SC is predominately an ovicide/larvicide and should be used early in the life cycle of mites.*

# Soybean disease management

Soybean grown in Wisconsin are subject to attack by several disease-causing organisms. Growers should learn to identify the major soybean diseases in order to distinguish them from poor plant health due to insects, adverse weather and soil conditions, herbicide injury, and nutrient deficiencies. Solutions to disease problems are generally quite different compared with solutions to insects, weeds, and other problems. Soybean diseases can be controlled or reduced by planting resistant or tolerant varieties, using a crop management system that fits your farming operation, and using agricultural chemicals—generally fungicides.

## Resistant or tolerant varieties

The use of disease-resistant or tolerant varieties is a practical and economical control for soybean diseases in Wisconsin. However, no soybean variety is resistant to all diseases. Carefully evaluate the major diseases on your farm and consider disease reactions when selecting soybean varieties. Disease reaction of soybean varieties can differ from year to year because the microorganisms that cause plant disease can change genetically and attack varieties that were formerly resistant. Soybean varieties also may have different reactions when grown under different cultural practices and weather conditions. Consult the publication *Wisconsin Soybean Variety Tests* (A3654) at [coolbean.info](http://coolbean.info) for information on specific varieties appropriate for your location.

## Crop management

The use of crop rotation and clean tillage are very powerful disease-control tools. Many fungal and bacterial pathogens of soybean survive between cropping seasons in soy-

bean crop debris. Once this crop residue is thoroughly decayed, these disease-causing organisms die out. Therefore, crop rotation and tillage programs that permit residue decomposition before the next crop is planted will help reduce diseases such as brown stem rot, *Sclerotinia* stem rot (white mold), pod and stem blight, anthracnose, stem canker, *Septoria* brown spot, *Cercospora* leaf spot (purple seed stain), bacterial blight and several other fungal and bacterial leaf diseases, and the soybean cyst nematode. Soil populations of the soybean cyst nematode can be minimized by crop rotation with nonhost crops.

Very few of the fungi and bacteria that attack soybean infect other crop plants. Rotations with corn, small grains, or most forages deprive soybean pathogens of a host on which to infect, reproduce, and carry over between soybean crops.

Adequate, balanced soil fertility also can be important in reducing disease losses. Less-than-adequate phosphorus or potash can result in increased losses from *Septoria* brown spot, soybean cyst nematode, several root rots, and pod and stem blight. Healthy, vigorous plants are more tolerant of diseases and better able to produce a near-normal yield despite the presence of diseases.

## Fungicides

### Fungicidal seed treatment

Treating soybean seeds may be beneficial to protect against certain pathogens (table 3-8) under the following conditions:

- Early planting in cold, wet soils.
- Reduced till and no-till fields.
- If germination is below 80% or there are other indications of

low seed vigor. Seed invaded by disease-producing organisms such as *Phomopsis* (pod and stem blight fungus) is more likely to respond to seed treatment.

- If the field is heavily infested with soybean root-invading fungi such as *Pythium*, *Rhizoctonia*, or *Phytophthora*.

Select the seed treatment fungicide to match pathogen pressure. Soil type, tillage, soil moisture and temperature, and seed health will influence the degree of pressure.

Follow the label for application rates and instructions. Apply fungicide seed treatments before applying a *Rhizobium* inoculum and plant seed immediately.

### Foliar fungicides

Foliar fungicides can be used to lower losses due to foliar and stem diseases. In some years, the stem rot pathogen *Sclerotinia* (white mold pathogen) can be damaging and an application of fungicide may improve yields in at-risk fields. Pod and stem blight may reduce yield, but its major effect is through seed infection (*Phomopsis* seed decay) that results in reduced seed germination and lower seedling vigor. Evaluations in Wisconsin reveal that foliar-applied fungicides reduce seed infection and improve germination. Foliar-applied fungicides for the control of some leaf diseases, white mold, and pod and stem blight have improved yields in Wisconsin tests, but results can be inconsistent.

Foliar fungicides might be considered for control of white mold (Table 3-11). Success using a fungicide to control this disease will depend on the field history of white mold, level of resistance in the variety grown, the weather prior to, and during, soybean bloom, and the yield potential of the

field. The following factors can contribute to increased risk of white mold:

- Fields that have high yield potential (>50 bu/a) and a history of white mold will be at risk.
- A susceptible variety was planted in a field with history of white mold.
- If the average 30-day temperature is at or below 70°F and wet for 30 days prior to bloom, the risk of infection by the white mold pathogen will be elevated. If conditions remain wet and/or humid during the bloom period, the risk for infection will further increase.

During these periods of high risk, a fungicide application targeted toward white mold management might reduce white mold levels and increase yield. Growers should also consider cost and the return on the investment in fungicide and application when making this decision. Each treatment costs about \$25 to \$40/a for the chemical, wetting agent, and application. Some fungicide products might require two applications to achieve acceptable control.

Soybean seed producers should consider the use of foliar fungicides to improve seed quality, taking the following factors into account:

- **Potential risk.** The diseases controlled by fungicide sprays are important when warm, wet weather prevails during the pod-fill stage. If, at bloom, the 30-day outlook is for warm, wet weather, these diseases will be active and fungicide sprays will be beneficial. Most product labels suggest two sprays, one at early pod development (upper pods 0.50 to 0.75 inches long) and a second spray 14 to 21 days later. However, if the weather has been dry since the first application and the forecast is for continued dry weather, do not spray a second time.
- **Was the field planted to soybean the previous year?** If you grow soybean for two or more consecutive years, disease severity poten-

tial will be higher than if you rotate crops.

- **No-till or minimum tillage.** This will increase the potential of disease if soybean are planted consecutive years (exception for white mold).
- **Early-maturing varieties.** These usually suffer greater losses from diseases controlled by foliar fungicides than full-season varieties.
- **Benefits of improved seed quality.** The benefits from disease control may be an important consideration for applying fungicides to seed-production fields.
- **High yields.** Higher yields, 50 bu/a or more, should be anticipated if fungicide application is to be economical.
- **Treatment cost versus expected benefit.** Each treatment costs about \$25 to \$40/a for the chemical, wetting agent, and application.
- **A dense canopy of weeds.** This will impede the movement of the fungicide to soybean pods and foliage.

Follow label instructions for application rates and additional application instructions.

### Soil-applied fungicides

These can be used for control of Phytophthora root rot. Ridomil Gold GR is a product registered for this purpose. Consider the following if you are thinking of using Ridomil Gold GR:

- **Potential risk.** Ridomil should be considered for fields with a history of frequent Phytophthora root rot. This disease can cause significant yield loss even without extensive plant death. Soils with high water-holding capacity are usually at greatest risk.
- **Soybean variety.** Ridomil performance is greatly affected by a variety's level of resistance or tolerance to Phytophthora root rot. Varieties that are highly tolerant have performed best with Ridomil use in

Wisconsin research trials. Varieties with full resistance respond less to Ridomil treatment. Ridomil should not be applied to a fully susceptible or low-tolerant soybean variety.

## Soybean diseases

### Phytophthora root rot

Phytophthora root rot may be found on soybean grown on any soil type, but soils with poor internal drainage are especially prone to Phytophthora problems. Young plants are very susceptible and die quickly, the resulting gaps in rows are the only evidence the disease is present. Older plants are killed more gradually or plant vigor is reduced throughout the growing season. Initial leaf symptoms are a progressive yellowing and wilting of leaves from the bottom to the top of the plant. The dead leaves generally remain attached for a week or more. Dead or dying plants have a brown discoloration of the stem progressing upward from the soil line.

**Variety selection and field monitoring.** Planting resistant varieties provides the highest level of protection against individual races of Phytophthora. So if the fungus exists in your fields, you'll need to know which races are prevalent. To determine which races are present in a field, plant several varieties that differ in reported resistance. This test is especially important when planting a variety in a specific field for the first time. Races of the pathogen can differ from field to field. Also, new races can become prevalent, and a soybean variety that has shown no Phytophthora root rot in past years can become very diseased. For this reason, it's important to monitor the performance of varieties with race-specific resistance. Be aware that many soybean varieties have the same source of resistance to Phytophthora root rot. Consult the publication Wisconsin Soybean Variety Tests at [coolbean.info](http://coolbean.info) for information on specific varieties.

**Resistant varieties.** Soybean varieties contain different genes for resis-

tance. Each gene confers resistance to specific races of *Phytophthora*. No one variety is resistant to all races. This form of resistance results in a very high level of control. Resistant varieties perform well across a wide range of environments; however, the appearance of a new race can result in severe disease.

**Tolerant varieties.** Many soybean varieties are not highly resistant to specific races of *Phytophthora* but vary in the degree of susceptibility to all races. Varieties with a low level of

susceptibility frequently are referred to as tolerant. Highly tolerant varieties can perform very well against *Phytophthora* root rot. However, performance of tolerant varieties can drop when conditions are highly favorable for this disease. Tolerance can be supplemented by use of appropriate cultural practices, formulations of seed treatment fungicides that contain mefenoxam or metalaxyl, and Ridomil soil treatment.

**Cultural practices.** *Phytophthora* root rot is most effectively suppressed

by avoiding susceptible varieties. The ability of varieties to resist *Phytophthora* root rot can be enhanced by the following cultural practices.

- Improve soil drainage.
- Avoid tillage practices or other field activities that enhance soil compaction.
- Ridge soil around the base of plants during cultivation to promote root growth from the lower stem. This may suppress *Phytophthora* root rot when the root rot

**Table 3-8.** Fungicides for treating soybean seeds for protection against *Fusarium*, *Rhizoctonia*, *Pythium*, *Phytophthora*, and *Phomopsis*<sup>a</sup>

Fungicide(s)	Sample formulations	Pathogens controlled					Remarks
		Fusa.	Rhiz.	Pyth.	Phyt.	Phom.	
abamectin + thiamethoxam + mefenoxam + fludioxonil	Avicta Complete Beans 500	-	x	x	x	x	For control of seedling diseases and seedling blights. Also contains an insecticide and nematicide.
<i>Bacillus subtilis</i>	HiStick N/T, Vault HP	-	x	-	-	-	Provides protection against several early-season root diseases. Can be applied with other compatible seed treatments but follow label directions closely.
carboxin + metalaxyl + captan	Bean Guard/ Allegiance	-	x	x	-	-	Combines the systemic action of carboxin and metalaxyl with the contact action of captan. Effective against <i>Pythium</i> and <i>Rhizoctonia</i> and show good activity against <i>Fusarium</i> and <i>Helminthosporium</i> .
fludioxonil	Maxim 4FS	-	x	-	-	x	Protects against <i>Rhizoctonia</i> and seed-borne <i>Phomopsis</i> . Use with Apron XL for broad-spectrum protection.
fludioxonil + mefenoxam	Apron Maxx RFC, Apron Maxx RTA, Apron Max RTA + Moly, Warden RTA	-	x	x	x	x	Protects against seed rot and seedling death caused by <i>Phomopsis</i> , <i>Phytophthora</i> , <i>Pythium</i> , and <i>Rhizoctonia</i> .
fludioxonil + mefenoxam + sedaxane	Vibrance Trio	x	x	x	x	x	Protects against seed-rot and damping-off. Provides early-season root rot protection caused by <i>Phytophthora</i> species.
fluopyram	ILevo	x	-	-	-	-	Provides control of sudden death syndrome of soybean and nematodes including soybean cyst nematode. Must be mixed with other seed treatments for control of additional seed rot fungal pathogens.
Extract of <i>Chenopodium quinoa</i>	Heads Up Plant Protectant	x	x	-	-	-	Provides control of sudden death syndrome. May provide suppression of white mold.
inpyrfluxam	Zeltera	x	x	-	-	-	Provides suppression of sudden death syndrome.

Abbreviations: Fusa. = *Fusarium virguliforme*; Rhiz. = *Rhizoctonia*; Pyth. = *Pythium*; Phyt. = *Phytophthora*; Phom. = *Phomopsis*

Key: x = labeled, no data; - = not labeled for this disease

<sup>a</sup> Follow label instructions for application rates and additional application instructions. Apply fungicide seed treatments before applying a *Rhizobium* inoculum and plant seed immediately.

Continued on next page

**Table 3-8.** Fungicides for treating soybean seeds for protection against *Fusarium*, *Rhizoctonia*, *Pythium*, *Phytophthora*, and *Phomopsis*<sup>a</sup> (continued)

Fungicide(s)	Sample formulations	Pathogens controlled					Remarks
		Fusa.	Rhiz.	Pyth.	Phyt.	Phom.	
ipconazole + metalaxyl	Rancona CTS, Rancona Summit, Rancona Xxtra, Rancona Xxtra Pro	-	x	x	x	x	May be applied with mechanical, slurry, or mist-type seed treating equipment. Seed should be sound and well cured before treatment.
ipconazole + metalaxyl + clothianidin + ethaboxam	Intego Suite Soybean	-	x	x	x	x	Contains clothianidin for control of wireworm, white grub, seedcorn maggot, and bean leaf beetle.
mefenoxam	Apron XL-RTA	-	-	x	x	-	Improves stands by controlling seed rot and seedling death caused by <i>Phytophthora</i> and <i>Pythium</i> . Has systemic activity. Will enhance performance of varieties with low to moderate resistance (tolerance) to <i>Phytophthora</i> .
metalaxyl	many	-	-	x	x	-	Improves stands by controlling seed rot and seedling death caused by <i>Phytophthora</i> and <i>Pythium</i> . Has systemic activity. Will enhance performance of varieties with low to moderate resistance (tolerance) to <i>Phytophthora</i> .
oxathiapiprolin	Lumisena	-	-	-	x	-	Seed treatment used to protect against <i>Phytophthora</i> seed, root, and stem rot and damping-off
prothioconazole + penflufen + metaxalyl	EverGol Energy SB	-	x	x	x	x	For control of seed decay and seedling diseases.
pydiflumetofen	Saltro	x	-	-	-	-	Provides control of sudden death syndrome of soybean and nematodes including soybean cyst nematode. Must be mixed with other seed treatments for control of additional seed rot fungal pathogens.
pyraclostrobin	Acceleron DX-109	-	x	-	-	-	Provides protection against seed and seedling disease due to <i>Rhizoctonia</i> and may provide suppression against <i>Pythium</i> spp.
sedaxane	Vibrance	-	x	-	-	-	For control of seed decay, seedling blight, and damping-off caused by <i>Rhizoctonia solani</i> .
<i>Streptomyces lydicus</i>	Actinogrow ST	-	x	x	x	-	Biological fungicide for suppression of early season root rot and damping-off fungi. Can be combined with other chemical seed treatment fungicides and/or insecticides.
thiabendazole	Mertect 340F	x	-	-	-	x	Provides protection against pod and stem blight on soybean seed. Can provide protection against sudden death syndrome using the high, labeled rate.
thiamethoxam + mefenoxam + fludioxonil	CruiserMaxx Plus, CruiserMaxx Plus EZ	-	x	x	x	x	Mefenoxam is active against <i>Pythium</i> and <i>Phytophthora</i> . Fludioxonil is active against <i>Fusarium</i> and <i>Rhizoctonia solani</i> and suppresses seed-borne <i>Sclerotinia</i> and <i>Phomopsis</i> .
thiamethoxam + mefenoxam + fludioxinil + sedaxane	Cruisermaxx Vibrance	-	x	x	x	x	For control of seedling diseases and seedling blights. Also contains an insecticide.

Abbreviations: Fusa. = *Fusarium virguliforme*; Rhiz. = *Rhizoctonia*; Pyth. = *Pythium*; Phyt. = *Phytophthora*; Phom. = *Phomopsis*

Key: x = labeled, no data; - = not labeled for this disease

<sup>a</sup> Follow label instructions for application rates and additional application instructions. Apply fungicide seed treatments before applying a *Rhizobium* inoculum and plant seed immediately.

Continued on next page

**Table 3-8.** Fungicides for treating soybean seeds for protection against *Fusarium*, *Rhizoctonia*, *Pythium*, *Phytophthora*, and *Phomopsis*<sup>a</sup> (continued)

Fungicide(s)	Sample formulations	Pathogens controlled					Remarks
		Fusa.	Rhiz.	Pyth.	Phyt.	Phom.	
thiamethoxam + mefenoxam + fludioxinil + sedaxane + <i>Pasteuria nishizawae</i> – Pn1	Clariva Elite Beans	x	x	x	x	x	Provides protection against damping-off and seed-borne rots. Also, provides protection against soybean cyst nematode.
<i>Trichoderma harzianum</i> <i>Rifai</i>	Rootshield	-	x	x	-	-	Preventative biological fungicide that protects against several root pathogens. Can be used with some other chemical fungicides, but consult compatibility charts for specific information.
thiram	many	-	x	x	-	x	Protects against seed rot; suppresses seedborne fungi.
tolclophos-methyl	Rizolex	-	x	-	-	-	Provides protection against <i>Rhizoctonia</i> and <i>Fusarium</i> species that cause seed and seedling rots.
trifloxystrobin	Trilex, Acceleron DX-709	-	x	-	-	-	Provides seed and seedling protection against seedborne fungi causing seed decay, soilborne pathogens, and <i>Rhizoctonia solani</i> and <i>Fusarium</i> spp.
trifloxystrobin + metalaxyl	Trilex 2000	-	x	x	-	x	Provides seed and seedling protection against seedborne fungi causing seed decay and the soilborne pathogens <i>Rhizoctonia solani</i> and <i>Pythium</i> spp.

Abbreviations: Fusa. = *Fusarium virguliforme*; Rhiz. = *Rhizoctonia*; Pyth. = *Pythium*; Phyt. = *Phytophthora*; Phom. = *Phomopsis*

Key: x = labeled, no data; - = not labeled for this disease

<sup>a</sup> Follow label instructions for application rates and additional application instructions. Apply fungicide seed treatments before applying a *Rhizobium* inoculum and plant seed immediately.

phase predominates. The lower soil moisture in the ridges creates a less favorable environment for *Phytophthora* activity.

**Chemical control.** For early *Phytophthora* root rot control, treat seed with a compound that has this disease on the label; treat only varieties with moderate to high tolerance. For longer control, apply Ridomil Gold GR.

### Brown stem rot

Brown stem rot (BSR) can reduce grain yield by 10 to 25%. Symptoms do not appear until after pod development has begun. The insides of stems turn brown and leaves gradually yellow, wilt, and die. The symptoms begin in August and early September, depending on the relative maturity of the variety. Due to the timing, BSR is often confused with early maturity. Yield loss due to BSR is greatest when the soybean crop is planted early and in

narrow rows. Brown stem rot resistant varieties and/or longer crop rotations may be most critical in this situation.

**Crop management.** Crop rotation can be used to control BSR. However, if growing susceptible varieties, you should have at least 2 years of a nonhost crop between soybean crops. Rotating soybean and corn on alternate years can result in yield loss due to BSR. Corn and small grains are excellent nonhost crops. Current research indicates that forage legumes, peas, and snap beans are not associated with increased severity of BSR. The risk of BSR declines as soil pH increases to 7.0 or above.

**Resistant varieties.** Both public and private soybean varieties are available with moderate to high levels of resistance to BSR. Consult the publication *Wisconsin Soybean Variety Tests* (A3654) at [coolbean.info](http://coolbean.info) for information on specific varieties. Watch

for foliar symptoms associated with “resistant” varieties. These symptoms may be caused by a breakdown of resistance by the BSR pathogen or a different pathogen.

**Integration of rotation and resistant varieties.** The movement to more integrated agricultural systems to reduce production costs makes an alternating soybean and corn rotation a seemingly desirable system. However, only 1 year of corn between soybean crops results in minimal suppression of the BSR fungus. Preliminary results from experiments in Iowa and Wisconsin suggest that varieties that are highly resistant to BSR reduce inoculum in the soil, but to a lesser degree than a year of corn. Thus, use of varieties resistant to BSR may take on added importance as the time interval between soybean crops is shortened. Although planting a variety resistant to BSR would be the most effective management

option, another option is to plant resistant and susceptible soybean varieties on an alternating basis each time soybean are planted in rotating corn or other nonhost of the BSR fungus. Brown stem rot is more severe in no-till fields than in conventional till. Therefore, longer crop rotations and/or resistant varieties should be considered if using no-till systems for soybean production.

### Sudden death syndrome

Sudden death syndrome (SDS) is a relatively new disease to Wisconsin but nationally it is one of the top five yield-limiting diseases. Symptoms of SDS include a yellow to brown discoloration of the leaves around the veins, which can be mistaken for brown stem rot (BSR). To differentiate the symptoms in the field, start by noting the growth stage (SDS typically expresses symptoms earlier in reproductive growth than BSR) and then digging plants out with a shovel so that the roots are intact. Split the stem; SDS does not lead to a brown discoloration of the vascular and pith tissue that is typical with BSR. When infection is severe, it is possible to see a blue coloration on the taproot. This is growth of the fungus. Keep in mind that SDS and BSR can occur together in the same plant, so it is important to properly diagnose the disease.

**Risk factors.** The pathogen that causes SDS overwinters in soybean debris as resistant fungal spores. Disease development is favored by high soil moisture during vegetative growth and wet and cooler conditions around flowering. Low spots or areas prone to water retention or poorly drained areas are more favorable for disease development. It is not uncommon to see very abrupt areas in the field where plants are severely infected while the neighboring plants are healthy.

**Dealing with SDS.** There is a known association of increased severity of SDS when the soybean cyst nematode (SCN) is present, although both can occur in the absence of each other. We strongly advise taking a soil

sample and submitting for testing for the presence of SCN from any field where SDS was noted. Management of SDS includes the use of resistant cultivars and the monitoring of conditions at planting to avoid cool soil temperatures that are favorable for infection by the pathogen. Very little varietal tolerance information exists in maturity group 2 and earlier soybean cultivars in Wisconsin; consult the Soybean Variety Trial Results at [coolbean.info](http://coolbean.info) for ratings for SDS when conditions warrant. Tillage should also be considered to help increase soil temperature and drainage, although crop rotation does not appear to have much of an impact on SDS as outbreaks have been noted after several other crops, including corn. Recent data suggest that new seed treatments such as Ileva and Saltro can suppress early infection of the SDS fungus and reduce yield losses. History and severity of the disease in a particular field in addition to cost of product and application should be considered when determining the utility of a seed treatment for management of SDS.

### Leaf diseases

Leaf diseases such as downy mildew, bacterial blight, powdery mildew, and brown spot are present in most soybean fields but generally do not cause significant yield losses. Frogeye leaf spot and *Cercospora* leaf spot, diseases normally found in the South, are becoming more prevalent in Wisconsin. Hot, humid weather favors development of these diseases.

Yield losses from leaf diseases may occur more frequently if soybean are planted after June 1, especially if downy mildew or powdery mildew develop. Under certain environmental conditions these diseases can occur early in the growing season and cause premature defoliation and subsequent yield losses. Early development of brown spot may indicate other health problems are present. Crop rotation, fall plowing to bury soybean debris, or application of foliar fungi-

cides at early podding can reduce the incidence of leaf diseases.

### Soybean rust

Soybean rust is a fungal disease that was first detected in the United States in 2004. Soybean are susceptible to rust infection at all growth stages. Infected plants have fewer pods, fewer seeds per pod, and poorly filled seeds. To date, losses due to soybean rust in the United States have been low, and the disease has not been observed in Wisconsin.

**Symptoms.** Symptoms first appear in the lower canopy with tiny gray spots forming on the undersides of leaves, often clustered near leaf veins. As the disease progresses, the spots rapidly increase in size and become visible on the upper side of the leaf as well as on petioles, stems, and pods. Spots change color, going from gray to tan to reddish-brown or black. Leaves turn yellow and drop prematurely. Early rust symptoms may be mistaken for downy mildew, brown spot, bacterial pustule, or frogeye leafspot.

There is no evidence that the soybean rust fungus will survive Wisconsin winters. As a result, the pathogen must be blown northward to reinfest fields each year. Disease development is favored by long periods of leaf wetness (at least 8 hours), high relative humidity (75 to 80%), and temperatures between 59 and 86°F. At higher temperatures, disease development slows or stops. Spores can be produced 10 days after infection and are continually released as long as environmental conditions are favorable.

**Scouting.** Early detection and a rapid response are critical to soybean rust management. To help guide scouting, monitor the soybean rust website on the ipmPIPE: <https://soybean.ipmPIPE.org/soybeanrust/>. Scout fields frequently, concentrating on early planted fields and early maturing varieties, and in fields that are subject to prolonged dews. Begin monitoring at soybean emergence and continue on a weekly schedule. Use a hand

lens to check lower leaves where rust symptoms are likely to show first.

To confirm diagnosis, select leaves representing the range of symptoms. Place the leaves between layers of cardboard and paper towels and place in a sealable plastic bag. Keep them cool until mailing and record as much field history information as possible. Send to the Plant Disease Diagnostics Clinic, Department of Plant Pathology, University of Wisconsin-Madison, 1630 Linden Drive, Madison, WI 53706-1598.

**Rust management.** Fungicides are the only in-season control practices that are effective against soybean rust. Method of control is considered either protectant or penetrant:

- **Protectant fungicides.** These prevent fungi from infecting and/or penetrating host tissue. These fungicides must be in place before plants are infected, or they will not control the disease. The strobilurin class of fungicides (azoxystrobin, pyraclostrobin, trifloxystrobin, etc) are all protectant fungicides.
- **Penetrant fungicides.** These can inhibit or stop the development of infections that are recently established. These fungicides are also able to slow disease development by limiting the pathogen's ability to produce new spores. This "post-infection activity" makes triazoles the fungicide of choice if soybean rust is established at low levels in a field. It is important to remember that triazoles do not have unlimited curative activity and are most effective when applied to plants with less than 10% infection in the lower canopy. Triazole fungicides may also be applied as a preventive, before disease infection.

### Soybean cyst nematode

The soybean cyst nematode (SCN) was first discovered in southeastern Wisconsin in 1980. Currently, this destructive root-infecting pathogen should be considered a threat in all soybean growing regions of Wisconsin.

Soybean cyst nematodes are microscopic roundworms that reside in the soil and live by extracting nutrients from soybean roots. Common foliar symptoms are yellowing and eventual premature death. Plants damaged by SCN are usually stunted and nodulation is often disrupted. Plant death may occur, but usually does not. Symptoms can be confused with other crop production problems such as nutrient deficiencies, injury from agricultural chemicals, soil compaction, and other soybean disorders. Populations of SCN can also interact with and intensify these disorders, and vice versa.

If high populations of SCN are present, plants show symptoms often before flowering. However, symptoms may not appear until pod set if low soil populations of SCN exist. Infected plants commonly occur in oval-shaped patches that vary in size and increase each year soybean are planted in an infested field. The affected area generally expands in the direction of tillage.

A laboratory soil analysis usually is necessary to determine the presence of SCN. However, you can diagnose SCN in the field by observing the cysts on the soybean root. Initially, the cysts are white, but they turn brown with time. The cysts are approximately the size of a pin head. Be careful not to confuse them with nodules caused by nitrogen-fixing bacteria.

**Sampling for SCN.** A soil analysis test can be used to confirm a suspected nematode problem or to eliminate SCN as one of several possible causes of poor plant growth. Soil samples can be taken any time of the year.

There are several ways to take a soil sample; the following is a general guide:

1. Use a soil probe or narrow-bladed trowel or shovel. Take samples close to plants at a depth of 8 to 10 inches. Discard the upper 2 inches of soil, especially if it is dry. Be sure to include plant roots.

2. Submit one sample for a 10-acre field or for a suspected area within the field. Sample soil and roots from 12 to 20 plants and mix into one sample; 1 to 2 pt of soil is adequate. Sample from plants in the margins of suspected areas and not from their centers.
3. Place samples in sturdy plastic bags, fasten the open end securely, and accurately label samples. Keep the samples from becoming dry and overheated. Mail samples early in the week to avoid delays in transit.

Laboratories will report the number of nematodes per unit of soil, usually per 100 cc of soil, or per gram of dry root. Growers and crop consultants may use these lab results to determine SCN damage potential (table 3-9). Nematode analysis laboratories are listed in table 2-15.

**Crop management.** To keep soil populations of SCN at non-damaging levels, rotate soybean with crops such as small grains, corn, alfalfa, and most vegetables (except peas, snap beans, lima beans, and dry-edible beans). The SCN can increase rapidly if soybean are frequently planted in the same field.

Two years of field studies indicate that you can expect higher populations of SCN if planting in areas of fields with soil pH levels above 7.0 as compared to areas with pH levels of 5.9 to 6.5. Damage is usually more severe in sandy soils, but will occur in all types of soil.

**Resistant varieties.** SCN-resistant soybean varieties are becoming available. However, control should start with crop rotation, which delays development of damaging levels of SCN and greatly enhances the performance of resistant soybean varieties. Sample soils to determine population levels of SCN. Resistant varieties should be planted in fields with more than 1,000 SCN eggs/250 cc of soil. Consult the Wisconsin Soybean Variety Tests at [coolbean.info](http://coolbean.info) for information on specific varieties.

**Table 3-9.** Risk assessment of soybean cyst nematode (SCN) by soil population and soil type

Risk	Egg count range/ 100 cc soil	Potential yield loss for SCN susceptible variety
None	0	none
Low	1–500	0–10% silt or clay soil 5–20% sandy soils
Moderate	500–2,000	10–20% silt or clay soils 10–40% sandy soils
High	2,000–5,000	20–50% all soils
Very high	> 5,000	30–70% 10–20% expected yield loss for resistant varieties <sup>a</sup>

<sup>a</sup> Soybean varieties with CystX resistance should be superior to other forms of SCN resistance in fields with very high SCN populations in the soil.

**Seed Treatments.** Poncho/VOTiVO is registered as a commercially applied soybean seed treatment for early season nematode protection. This product can only be applied using commercial seed treatment equipment. Consider nematode seed treatments methods only in combination with crop rotation and the use of resistant varieties.

### Diaporthe pod and stem blight

Pod and stem blight is a conspicuous disease of maturing soybean. Plants are infected throughout the season, but conspicuous symptoms do not appear until 2 to 3 weeks before maturity. Symptoms are small, black fruiting bodies that look like specks on maturing soybean stems and pods. Severe infection by the *Diaporthe* fungus does not always mean a reduction in yield, but it generally results in reduced quality of seed for market or future planting. This is the *Phomopsis* seed decay phase of pod and stem blight. Infected seed may show no detectable symptoms or can be in some stage of decay. Visibly infected seeds are a discolored brown, shriveled, and often covered with white mold. This disease is favored by warm, wet weather during late pod fill.

**Control.** *Diaporthe* pod and stem blight can be controlled or reduced by integrating one or more of the fol-

lowing practices: use pathogen-free seed, delay planting, practice crop rotation, deep-plow soybean debris, harvest as early as possible, and apply registered fungicides at early podding (see the section on fungicides). Resistant varieties are not known, but early-maturing varieties generally are more susceptible. Seed treatments are useful when *Phomopsis*-infected seed must be sown. Plant-disease diagnostic laboratories can examine seed lots to determine approximate amounts of infection that may be present in seed. Narrow-row production does not increase pod and stem blight (*Phomopsis* seed decay).

### Sclerotinia stem rot (white mold)

Sclerotinia stem rot (also called white mold) is characterized by dying plants in which the stems are covered with white mycelium and hard black structures called sclerotia. Sclerotia also form inside infected stems. Sclerotinia stem rot can be confused with *Phytophthora* root rot. Close inspection of affected plants is very important. Sclerotinia stem rot is favored by cool to moderate temperatures and high humidities in the crop canopy, especially during the flowering phase of crop development.

The risk of Sclerotinia stem rot is greatest when soybean are grown in

high-yield environments. Narrow-row production, early planting, plant populations greater than 160,000 plants per acre, irrigation, and high soil fertility are management practices that increase the risk of Sclerotinia stem rot. Variety selection is critical under these conditions.

**Control.** Sclerotinia stem rot management recommendations are based on the amount of disease that has been present in the field and on the relative resistance or susceptibility of the soybean variety planted. Refer to table 3-11 for specific recommendations.

Soybean varieties differ in susceptibility to Sclerotinia stem rot. Complete resistance to Sclerotinia is not available. Disease reactions of soybean varieties are greatly influenced by environmental conditions. Consult the publication Wisconsin Soybean Variety Tests (A3654) for information on specific varieties.

The Sclerotinia stem rot fungus survives for years in the absence of a favorable host. Two years of a nonhost crop reduces but does not eliminate the risk of Sclerotinia stem rot. Corn and small grains are excellent nonhost crops to rotate with soybean; sunflowers, lima beans, and snap beans are hosts and increase the potential of Sclerotinia stem rot in soybean. Many broadleaf weeds are also hosts. Thus, control of broadleaf weeds in the non-host crop year is critical.

There are several fungicides labeled for use in soybean for the control of Sclerotinia stem rot. However, most are only moderately effective and need to be applied when flowers are present on the lower half of the stem.

Herbicides containing lactofen (Cobra, Phoenix) will suppress white mold if applied at or before first bloom. Check the label for rates and adjuvant recommendations.

Sclerotia of the Sclerotinia stem rot fungus are long-lived in soil but are subject to attack by many soil organisms. One commercially available biological control product, Contans WG, is labeled to control Sclerotinia

stem rot in agricultural soils. Contans WG is applied in water to the soil surface, usually during preplanting or post-harvest on the stubble of a previously diseased crop. Contans WG can be sprayed just ahead of the tillage equipment. It should be incorporated within 24 hours after spraying, ideally immediately after spraying. Contans WG can be incorporated with irrigation on sandy soils and some peat soils. It may be tank mixed and applied with herbicides such as trifluralin or glyphosate. Do not mix Contans with any other fungicide. Read and follow label directions. The more time between treatment and the typical onset of disease, the better.

### Alfalfa mosaic virus

Alfalfa mosaic virus (AMV) was detected in soybean for the first time in 1999. Most AMV inoculum is introduced into soybean fields by aphids that acquire the virus from forage legumes. Transmission occurs throughout the season. Infected leaves may have a bright yellow mosaic or the leaf veins may turn yellow, but the rest of the leaf remains the normal green color.

**Control.** No genes with resistance have been reported. Soybean planted early in the season appear to be less affected by the disease.

### Bean pod mottle virus

Bean pod mottle virus (BPMV) was first detected in Wisconsin in 1999. Bean leaf beetles feed on infected forage legumes and transmit the virus to soybean throughout the season. Young leaves in the upper canopy exhibiting light green to yellow mottling. Some leaves become puckered and distorted. Stems remaining green after pods have matured retain petioles after leaf blades drop. The virus survives in insects over the winter.

**Control.** Tolerant varieties are reported, but varieties are not characterized for reaction to BPMV. Management of bean leaf beetle is key to control of

virus (see the insect section for recommendations). Delay planting until mid-May to avoid feeding by overwintered bean leaf beetles.

### Soybean mosaic virus

The soybean mosaic virus (SMV) occurs in Wisconsin, but yield loss has not been documented. Infected leaves develop a mosaic of light and dark green areas and chlorosis may develop between the dark green areas. Leaf surfaces become raised or blistered and leaf margins may be wavy or curl downward. Most infected plants are slightly stunted, have fewer pods, and mature later. Infected seed, a major source of inoculum, may be discolored. Aphids feed on infected plants and transmit SMV to healthy plants throughout the season.

**Control.** Plant virus-free seed. Varieties appear to differ in susceptibility but they are not characterized for reaction to SMV. Soybean planted early in the season appear to be less affected by the disease.

### Soybean vein necrosis virus

Soybean vein necrosis virus (SVNV) causes soybean vein necrosis (SVN) is a relatively recent discovery in soybean. SVN was first described in 2008 in Tennessee and was confirmed in Wisconsin in 2012. Soybean plants with SVN exhibit vein clearing (i.e., lightening of vein color) and chlorosis (i.e., yellowing), as well as mosaic patterns (i.e., blotchy light and dark areas) on affected leaves. Initially, symptoms develop around the veins of leaves and eventually expand outward. As the disease progresses, vein and leaf browning and necrosis (i.e., death) occur. Researchers do not know if SVN can lead to significant yield reductions. Recent research in Wisconsin found that SVNV can be transmitted in soybean seed at a rate of around 6%.

**Control.** Plant seed that appears healthy and is not visually damaged.

### Tobacco streak virus

Tobacco streak virus (TSV) is widespread in Wisconsin but yield loss is not known. This disease was detected in soybean for the first time in 1999. Infected leaves acquire a mild mosaic coloring of yellow and green. Leaf and flower buds may be excessively proliferous. Maturity is delayed in infected plants and plants remain green. Most TSV inoculum is introduced into soybean fields as infected seed. Thrips transmit TSV to healthy plants throughout the season.

**Control.** Varieties appear to differ in reaction to TSV although genes with resistance to the virus have not been reported. Soybean planted early in the season appear to be less affected by the disease.

**Table 3-10.** Fungicide efficacy ratings for foliar soybean diseases in Wisconsin

Fungicide	Alternaria leaf spot	Anthrachnose	Cercospora leaf blight	Frogeye leaf spot	Pod and stem blight	Powdery mildew	Septoria brown spot	Soybean rust	White mold	Active ingredient(s)	Chemical family (FRAC code <sup>a</sup> )	Amount/use/a	Preharvest interval (PHI)
AfterShock	x	x	4	4	x	-	3	x	-	fluoxastrobin	Qol (11)	2.0–5.7 fl oz	Apply no later than R5
<b>Remarks:</b> Do not apply more than 22.8 fl oz/a per year or more than four applications per year. Do not apply within 14 days of harvest.													
Alto 100 SL	x	x	x	4	x	-	8	8	-	cyproconazole	triazole (3)	2.75–5.5 fl oz	30 days
<b>Remarks:</b> Do not apply more than 11 fl oz/a/season. Do not graze within 14 days of application or apply more than 0.072 lb ai/a/year of cyproconazole-containing products. Do not use soybean forage or hay as livestock feed if making more than one application at 5.5 fl oz/a.													
AmTide Propiconazole	-	8	-	4	-	-	6	8	-	propiconazole	Qol (11)	4.0–6.0 fl oz	Do not apply after R6
<b>Remarks:</b> Do not apply more than 12 fl oz/a per season.													
Approach	x	6	2	2	x	x	3	6	5	picoxystrobin	Qol (11)	6.0–12.0 fl oz	14 days
<b>Remarks:</b> Make no more than two sequential applications before switching to a fungicide with a different mode of action. Do not exceed 12 fl oz/a per crop if grown for forage and hay. Do not exceed 36 fl oz/a per crop.													
Approach Prima	x	x	3	5	x	x	6	9	-	picoxystrobin + cyproconazole	Qol (11) triazole (3)	5.0–6.8 fl oz	30 days for grain, 14 days for forage or hay
<b>Remarks:</b> Do not apply more than 13.6 fl oz of product/a per year. Do not apply more than two sequential application of fungicide products containing a Qol (11) component. Do make more than one application of 6.8 fl oz/a per crop if the intention is to use soybean as forage or hay for livestock.													
Avaris	x	x	4	4	x	-	6	8	-	azoxystrobin + propiconazole	Qol (11) + triazole (3)	14.0–20.5 fl oz	Do not apply within 21 days of harvest
<b>Remarks:</b> Do not apply more than 42 fl oz/a per season. Do not apply more than 0.34 lb ai/a of propiconazole-containing products per season. Do not apply more than 1.5 lb ai/a of azoxystrobin-containing products per season.													
Bravo Weather Stik	-	x	x <sup>b</sup>	x	x	-	x	x	-	chlorothalonil	chloronitrile (M5)	1.0–2.25 lb	6 weeks
<b>Remarks:</b> Do not apply more than 6 pt/a during each growing season. Do not feed hay or threshings from treated fields to livestock													
Cercobin	-	x	4	8	x	-	x	6	4	thiophanate-methyl	thiophanates (1)	10.0–20.0 fl oz	21 days
<b>Remarks:</b> Do not make more than two applications/year or apply more than 40 fl oz/a/year. Do not graze or feed treated vines or hay to livestock.													
Custodia	x	8	4	5	x	x	8	x	-	azoxystrobin + tebuconazole	Qol (11) triazole (3)	8.6 fl oz	21 days
<b>Remarks:</b> Do not apply more than 25.9 fl oz/A of Custodia per crop. Do not apply more than 0.34 lb a.i. of tebuconazole-containing products/A/season. Do not apply more than 1.5 lb a.i. of azoxystrobin-containing products/A/season													
Cuprofix Ultra 40 Disperss	x	-	x	x	x	x	x	-	-	copper sulfate	inorganic (M1)	0.75–2.0 fl oz	Not listed.
<b>Remarks:</b> Consult the label for disease specific recommendations and rates.													
Delaro	-	x	x	7	x	x	8	x	-	prothioconazole + trifloxystrobin	triazole (3) + Qol (11)	8.0 – 11.0 fl oz/a	21 days
<b>Remarks:</b> Do not apply more than 33.0 fl oz/season. Do not apply more than two sequential applications of any other group 11 fungicide without alternating with a fungicide of another group. Do not apply more than 3 applications per year. Do not graze or feed forage or hay.													

Efficacy rating: 10 = excellent; 8 = very good; 6 = good; 4 = fair; 2 = poor; 0 = no control

Key: x = labeled, no data; - = not labeled for this disease

<sup>a</sup> FRAC codes indicate the modes of action for each fungicide; multiple applications of fungicides from the same group increases the chances for the fungus developing resistance.<sup>b</sup> Suppression only.

Continued on next page

**Table 3-10.** Fungicide efficacy ratings for foliar soybean diseases in Wisconsin (continued)

Fungicide	Alternaria leaf spot	Anthrachnose	Cercospora leaf blight	Frogeye leaf spot	Pod and stem blight	Powdery mildew	Septoria brown spot	Soybean rust	White mold	Active ingredient(s)	Chemical family (FRAC code <sup>a</sup> )	Amount/use/a	Preharvest interval (PHI)
Delaro Complete	x	x	x	x	x	x	x	x	4	prothioconazole +trifloxystrobin +fluopyram	triazole (3) + Qol (11) + carboximide (7)	8.0 – 11.0 fl oz/a	21 Days
Remarks: Do not apply more than 33.0 fl oz/season. Do not apply more than two sequential applications of any other group 11 fungicide without alternating with a fungicide of another group. Do not apply more than 3 applications per year. Do not graze or feed forage or hay.													
Domark 230 ME	-	8	4	5	x	x	8	9	4	tetraconazole	triazole (3)	4.0–5.0 fl oz	Do not apply after R5.
Remarks: Do not make more than two applications/year. Do not apply more than 10 fl oz/a/season. Do not graze or feed soybean forage or hay to livestock.													
Echo 720 Echo 90 DF Echo ZN	-	x	x	x	x	-	x	x	-	chlorothalonil	chloronitrile (M5)	1.0–2.25 pt .875–2.0 lb 1.5–3.5 pt	42 days
Remarks: Do not feed soybean or threshings from treated fields to livestock.													
Endura	x	-	x	2	-	-	8	-	7 <sup>b</sup>	boscalid	carboximide (7)	3.5–11.0 fl oz	21 days
Remarks: Do not make more than two applications/year. Do not apply more than 22 fl oz/a per year.													
Equation	x	8	2	2	x	-	3	7	-	azoxystrobin	Qol (11)	6.0–15.5 fl oz	14 days
Remarks: Do not apply more than 92.3 fl oz of product/a/season or make more than one application at 15.5 fl oz product/a or 0.25 lb ai/a to soybean forage and hay. Do not apply more than 1.5 lb ai/a/season of azoxystrobin-containing products.													
Equus 720 SST Equus DF	-	x	x	x	x	-	x	x	-	chlorothalonil	chloronitriles (M5)	1.0-2.25 pts 0.9-3.1 lbs.	42 days
Remarks: Do not feed hay or threshings from fields treated with Equus. Do not apply more than 6.0 pts of the SST formulation or 5.4 lbs of the DF formulation per season.													
Evito 480 SC	x	x	4	4	x	-	3	x	x	fluoxastrobin	Qol (11)	2.0–5.7 fl oz	Do not apply after R5
Remarks: Apply no more than 24 fl oz/season. Apply no more than two applications/season.													
Evito T	x	x	x	x	x	-	x	x	-	fluoxastrobin + tebuconazole	Qol (11) + triazole (3)	4-6 fl oz	30 days for grain; 21 days for fodder
Remarks: Do not apply more than 12 fl oz per acre per year. Do not make more than two applications per season.													
Fortix Preemptor	x	x	4	7	x	x	7	x	x	fluoxastrobin + flutriafol	Qol (11) triazole (3)	4.0–6.0 fl oz	R5 growth stage or 30 days
Remarks: Do not apply more than 12 fl oz/a/season. Do not feed treated soybean as forage or allow animals to graze.													
Headline EC Headline SC	x	8	2	2	x	-	4	8	-	pyraclostrobin	Qol (11)	6.0–12.0 fl oz	21 days
Remarks: Apply no more than two applications/season before alternating with a labeled non-Group 11 fungicide with a different mode of action.													

Efficacy rating: 10 = excellent; 8 = very good; 6 = good; 4 = fair; 2 = poor; 0 = no control

Key: x = labeled, no data; - = not labeled for this disease

<sup>a</sup> FRAC codes indicate the modes of action for each fungicide; multiple applications of fungicides from the same group increases the chances for the fungus developing resistance.<sup>b</sup> Suppression only.

Continued on next page

**Table 3-10.** Fungicide efficacy ratings for foliar soybean diseases in Wisconsin (continued)

Fungicide	Alternaria leaf spot	Anthrachnose	Cercospora leaf blight	Frogeye leaf spot	Pod and stem blight	Powdery mildew	Septoria brown spot	Soybean rust	White mold	Active ingredient(s)	Chemical family (FRAC code <sup>a</sup> )	Amount/use/a	Preharvest interval (PHI)
Incognito 4.5F Incognito 85WDG	-	x	4	8	x	-	x	6	4	thiophanate-methyl	thiophanate (1)	10.0–20.0 fl oz 0.4–0.8 lbs	21 days
<b>Remarks:</b> Do not make more than two applications/year. Do not graze or feed treated vines or hay to livestock.													
Miravis Neo	x	x	x	x	x	x	x	x	4 <sup>b</sup>	pydiflumetofen + azoxystrobin + propiconazole	carboximides (7) + Qol (11) + triazole (3)	13.7 – 20.8 fl oz	14 days for grain
<b>Remarks:</b> Do not feed soybean hay, forage, and silage. Maximum annual use rate is 42 fl oz/A.													
Muscle 3.6 F	-	-	-	-	-	-	-	7	-	tebuconazole	triazole (3)	3.0–4.0 fl oz	21 days
<b>Remarks:</b> Maximum application of 12 fl oz/a per season.													
Omega Lektivar	-	-	-	-	-	-	-	-	7	fluazinam	uncouplers of oxidative phosphorylation (29)	0.75–1.0 pt	Do not apply after R3
<b>Remarks:</b> Do not apply more than 2 pt/a per growing season. Do not allow livestock to graze treated areas or feed hay from treated fields to livestock.													
Orius 3.6F	-	-	-	-	-	x	-	7	-	tebuconazole	triazole (3)	3.0–4.0 fl oz	21 days
<b>Remarks:</b> Do not apply more than three applications or 12 fl oz/a per season.													
Oxidate 2.0	-	x	-	-	-	x	-	-	x	hydrogen dioxide + peroxyacetic acid	unknown (u)	1:400- 1:40 dilution	0 days
<b>Remarks:</b> in fields with a history of disease use the highest labeled rate. Test with potential tank-mix partners prior to application to determine compatibility. Frequent and repeated applications may be necessary when conditions are conducive for disease.													
Priaxor	x	8	4	3	x	-	7	8	3 <sup>b</sup>	fluxapyroxad + pyraclostrobin	carboximides (7) + Qol (11)	4.0–8.0 fl oz	21 days for grain
<b>Remarks:</b> Apply no more than two applications per season. Do not apply more than 16 fl oz/a per season.													
Proline 480 SC	-	-	-	8	-	x	-	8	5 <sup>b</sup>	prothioconazole	triazole (3)	2.5–5.0 fl oz	21 days
<b>Remarks:</b> Do not apply more than three applications per season. Do not apply more than 12.9 fl oz/a/season.													
Propicure 3.6F	-	8	-	4	-	-	6	8	-	propiconazole	triazole (3)	4.0–6.0 fl oz	Apply up to R6
<b>Remarks:</b> Do not apply more than 12 fl oz/a per season.													
Propulse	-	-	-	x	x	x	x	x	x	fluopyram + prothioconazole	carboximides (7) + triazole (3)	6.0 – 10.2 fl oz	21 days
<b>Remarks:</b> Do not allow livestock to graze. Do not feed soybean forage as hay or forage. Do not make more than two sequential applications or apply more than 30.9 fl oz/A per year.													
Quadris	x	8	2	2	x	-	4	7	-	azoxystrobin	Qol (11)	6.0–15.5 fl oz	14 days
<b>Remarks:</b> Do not apply more than 92.3 fl oz of product/a/season or make more than one application at 15.5 fl oz product/a or 0.25 lb ai/a to soybean forage and hay. Do not apply more than 1.5 lb ai/a/season of azoxystrobin-containing products.													

Efficacy rating: 10 = excellent; 8 = very good; 6 = good; 4 = fair; 2 = poor; 0 = no control

Key: x = labeled, no data; - = not labeled for this disease

<sup>a</sup> FRAC codes indicate the modes of action for each fungicide; multiple applications of fungicides from the same group increases the chances for the fungus developing resistance.<sup>b</sup> Suppression only.

Continued on next page

**Table 3-10.** Fungicide efficacy ratings for foliar soybean diseases in Wisconsin (continued)

Fungicide	Alternaria leaf spot	Anthraxnose	Cercospora leaf blight	Frogeye leaf spot	Pod and stem blight	Powdery mildew	Septoria brown spot	Soybean rust	White mold	Active ingredient(s)	Chemical family (FRAC code <sup>a</sup> )	Amount/use/a	Preharvest interval (PHI)
Quadris Top	x	x	4	8	5	x	7	8	-	azoxystrobin + difenoconazole	Qol (11) + triazole (3)	8.0–14.0 fl oz	14 days
<b>Remarks:</b> Do not apply more than 26.5 fl oz/a per season or more than 0.22 lb ai/a of difenoconazole-containing products/season. Do not apply more than 1.5 lb ai/a of azoxystrobin-containing products per season. Do not feed soybean hay, forage, and silage.													
Quadris Xtra	x	x	x	x	x	-	x	x	-	azoxystrobin + cyproconazole	Qol (11) + triazole (3)	4.0–6.8 fl oz	30 days
<b>Remarks:</b> Do not apply more than 13.6 fl oz /a/season. Do not graze forage within 14 days of application. Do not apply more than 0.072 lb ai/a/year of cyproconazole-containing products. Do not apply more than 1.5 lb. ai/a/year of azoxystrobin-containing products. Do not use soybean forage or hay as livestock feed if making more than one application at 6.8 fl oz product/a.													
Quilt	x	x	4	4	x	-	6	8	-	azoxystrobin + propiconazole	Qol (11) + triazole (3)	14.0–20.5 fl oz	21 days for seed and 0 days for forage and hay
<b>Remarks:</b> Do not apply more than 42 fl oz/a/season. Do not apply more than 0.34 lb ai of propiconazole-containing products/a/season. Do not apply more than 1.5 lb ai of azoxystrobin-containing products/a/season.													
Quilt Xcel	x	8	4	4	x	-	6	8	-	azoxystrobin + propiconazole	Qol (11) triazole (3)	10.5–21.0 fl oz	Apply up to stage R6
<b>Remarks:</b> Do not apply more than 42 fl oz/a/crop. Do not apply more than 0.34 lb ai of propiconazole-containing products/a/season. Do not apply more than 1.5 lb ai of azoxystrobin-containing products/a/season.													
Revytek	x	x	5	8	x	-	8	10	2	mefentrifluconazole + pyraclostrobin + fluxapyroxad	triazole (3) + Qol (11) + carboximides (7)	8.0-15.0 fl oz	21 days
<b>Remarks:</b> Do not apply more than 30 fl oz per acre per year. Applications for white mold will result in suppression only.													
Stratego YLD	x	8	4	5	x	x	6	8	-	prothioconazole + trifloxystrobin	triazole (3) + Qol (11)	4.0–4.65 fl oz	21 days
<b>Remarks:</b> Do not apply more than three applications per season. Do not apply more than 13.95 fl oz/a/ season. Do not graze or feed soybean forage or hay. Do not apply more than two sequential applications of Stratego YLD or any other Group 11-fungicide without alternating with a fungicide from another group.													
TebuStar 3.6L Tebuzol	-	-	-	-	-	n	-	7	-	tebuconazole	triazole (3)	3.0–4.0 fl oz	21 days
<b>Remarks:</b> Do not apply more than three applications/season. Do not apply more than 12 fl oz/a per season.													
Tilt	-	8	-	4	-	-	6	8	-	propiconazole	triazole (3)	4.0–6.0 fl oz	Apply up to stage R6
<b>Remarks:</b> Do not apply more than 12 fl oz/a/season. Do not apply more than 0.34 lb ai propiconazole- containing product/a/season.													
Topaz	-	x	-	x	-	-	-	7	-	tebuconazole	triazole (3)	4.0–6.0 fl oz	Apply up to R6
Topsin M 70 WP	-	x	4	8	x	-	x	6	4	thiophanate-methyl	thiophanates (1)	0.5–1.0 lb	21 days
Topsin M WDG	-	x	4	8	x	-	x	6	4	thiophanate-methyl	thiophanates (1)	0.5–1.0 lb	
Topsin M WSB	-	x	4	8	x	-	x	6	4	thiophanate-methyl	thiophanates (1)	0.5–1.0 lb	
<b>Remarks:</b> Do not apply more than 2 lb/a/year. Do not graze or feed treated vines or hay to livestock.													

Efficacy rating: 10 = excellent; 8 = very good; 6 = good; 4 = fair; 2 = poor; 0 = no control

Key: x = labeled, no data; - = not labeled for this disease

<sup>a</sup> FRAC codes indicate the modes of action for each fungicide; multiple applications of fungicides from the same group increases the chances for the fungus developing resistance.

<sup>b</sup> Suppression only.

Continued on next page

Principles of pest management

Corn weeds

Soybean disease

Forages & pastures

Small grains

Stored grain insects

Appendix

**Table 3-10.** Fungicide efficacy ratings for foliar soybean diseases in Wisconsin (continued)

Fungicide	Alternaria leaf spot	Anthrachnose	Cercospora leaf blight	Frogeye leaf spot	Pod and stem blight	Powdery mildew	Septoria brown spot	Soybean rust	White mold	Active ingredient(s)	Chemical family (FRAC code <sup>a</sup> )	Amount/use/a	Preharvest interval (PHI)
Topguard	-	8	4	7	-	x	8	9	3	flutriafol	triazole (3)	7.0–14.0 fl oz	21 days
<b>Remarks:</b> Do not apply more than 28 fl oz/a/season. Do not apply more than three applications per growing season. No single application may exceed 14 fl oz/a. Only one application at 14 fl oz/a may be made to any one field during a single growing season. Apply only to soybean harvested for dry seed. Only soybean may be rotated to treated fields. Do not feed forage or hay or permit animals to graze.													
Topguard EQ	x	x	x	7	x	x	8	10	x	flutriafol + azoxystrobin	triazole (3) + Qol (11)	5.0–7.0 fl oz	21 days
<b>Remarks:</b> Do not apply more than 15.5 fl oz/a/season. Do not apply more than three applications per growing season. Only one application per season can be applied at 7.0 fl oz/a. Only soybean may be rotated to treated fields. Do not feed forage or hay or permit animals to graze.													
Trivapro	x	x	4	5	x	x	7	9	-	benzovindiflupyr + azoxystrobin + propiconazole	carboximides (7) + Qol (11) + triazole (3)	13.7 – 20.7 fl oz	Do not apply after the R6 growth stage
<b>Remarks:</b> Do not apply more than 2 applications per year. Do not apply more than 41.4 fl oz per acre per year. Do not feed soybean hay, forage, and silage to livestock.													
Veltyma	x	x	x	x	x	-	x	x	-	mefentrifluconazole + pyraclostrobin	triazole (3) + Qol (11)	7.0–10.0 fl oz	21 days
<b>Remarks:</b> Do not apply more than 20 fl oz per acre per season. Do not apply more than 2 applications per year.													
Viathon	-	-	-	x	-	x	x	x	-	potassium phosphite + tebuconazole	phosphonate (33) + triazole (3)	1.5 pt	21 days
<b>Remarks:</b> Recommended to tank-mix 6 fl. oz. per acre Quilt fungicide. Do not apply more than 4.3 pints of Viathon per year.													

Efficacy rating: 10 = excellent; 8 = very good; 6 = good; 4 = fair; 2 = poor; 0 = no control

Key: x = labeled, no data; - = not labeled for this disease

<sup>a</sup> FRAC codes indicate the modes of action for each fungicide; multiple applications of fungicides from the same group increases the chances for the fungus developing resistance.

<sup>b</sup> Suppression only.

**Table 3-11.** Management recommendations for Sclerotinia stem rot (white mold)

Field history (% disease)	Management recommendations <sup>a,b</sup>
0%	Plant pathogen-free seed. Maintain current row width and plant population. Avoid crops that are susceptible to white mold in the rotation.
< 5%	<p><b>If disease is...</b></p> <p><b>(1) present in pockets:</b> Avoid planting susceptible soybean varieties. Maintain current row width and plant population. Rotate out of soybean for at least 1 year.</p> <p><b>(2) spread throughout field:</b> Plant partially resistant varieties. Maintain current row width, but reduce plant population if planting less-resistant varieties. Rotate out of soybean for at least 1 year.</p>
5–25%	<p><b>If soybean variety is...</b></p> <p><b>(1) partially resistant:</b> Maintain current row width and plant population. Rotate out of soybean for at least 1 year.</p> <p><b>(2) moderately susceptible:</b> Widen row width to 30 inches and lower seeding rate accordingly. Rotate out of soybean for at least 1 year. Consider treating fields with a fungicide at flowering.</p>
25–50%	Select partially resistant varieties. Widen row width (30 inches preferred) and lower the plant population. Rotate 1 to 2 years out of soybean. Consider treating field with a fungicide at flowering.
> 50%	Plant varieties with as much resistance as possible. Plant in wider row-spacings. Consider also using seeding rates between 100,000 and 140,000 seeds/a. Rotate 2 to 3 years out of soybean. Fungicide treatment necessary for susceptible varieties — apply when flowers are present, especially on lower half of stems (R1-R3 growth stage).

<sup>a</sup>Variety resistance rankings: resistant = <5% mortality, high yield; partially resistant = 5–25% mortality, high yield; moderately susceptible = 26–50% mortality, variable yield; susceptible = 26–50% mortality, low yield; highly susceptible = >50% mortality, low yield

<sup>b</sup>Optimum seeding rates for fields with a high risk for white mold: between 100,000 and 140,000 seeds/a for 15- and 30-inch rows.

Source: <https://cropprotectionnetwork.org/web-books/white-mold-of-soybean>

# FORAGE AND PASTURE PEST MANAGEMENT

# Forage and pasture weed management

Wisconsin has millions of acres of harvested forages and pastures that serve as the base of our livestock enterprises. Weeds can cause economic losses in forages and pastures unless management practices are in place to contain them. This section will discuss weed management in legume forages and then in grass pastures.

## Forage legumes

Weed management tools are much more limited in forage crops compared to grain crops. The only opportunities to use mechanical methods of weed management are during seedbed preparation before establishment or when harvesting forage. As a result, growers rely upon herbicides and competition from forage to suppress weeds. After the seeding year, weeds are seldom a problem as long as the stand remains vigorous and dense. Weedy fields usually occur when stands decline (a sign that rotation to another crop is required) or are stressed. Weeds can be suppressed with mowing (or grazing); however, weed species can affect feed quality and palatability. Herbicide use is common in newly seeded stands but less common in established stands. Legume establishment with a cover crop is discussed in the **Small Grains** section of this manual.

## Establishing forage legumes without a cover crop (direct seeding)

Historically, small-seeded legumes in Wisconsin have been sown with a small grain cover crop, but today most growers establish forage legumes without a companion crop. (See the

**Small Grains** section for details about weed management when legumes are seeded with cereals.) While direct seeding can enhance alfalfa yields in the establishment year, small-seeded legumes grow slowly, leaving the soil surface exposed and subject to erosion. Therefore, direct seeding on erodible slopes is not recommended. In these cases, consider planting with a no-till drill and using a temporary cover crop as discussed later. Because small-seeded legumes are poor competitors until they are established, adequate weed control in the seeding phase can enhance desirable forage quantity and quality.

The postemergence herbicides available in forages make it possible to practice the IPM principle of “treat as needed.” Scout fields weekly after legume emergence and consider using the appropriate herbicide or herbicide combination if weed cover is moderate to high (equal to more weeds vs alfalfa). There is no need to treat if weed cover is low (more alfalfa vs weeds).

The impact of weeds on forage quality varies by the weeds present, their density and growth stage when

harvested. Table 4-1 compares the relative seriousness of common annual and perennial weeds in forages. These rankings are based on laboratory analyses and feeding studies with animals done by several Midwestern universities.

Some of these species may be adequate in terms of forage value but present other problems. For example, pigweed and lambsquarters may be nutritious but can also accumulate nitrates, especially in nitrogen-rich soils and when rain follows a prolonged dry period. Cocklebur and nightshade are in the “serious” category because they contain poisonous compounds. Pennycress imparts a garlicky flavor to milk.

The herbicides listed in tables 4-2a and 4-2b control many weeds in direct-seeded legume establishment. Most treatments have little effect on perennial weeds, and special control measures for such species should be used while the field is in other crops.

**Table 4-1.** Impact of common weeds on forage quality

	Relative seriousness		
	high	moderate	slight
<b>Annual weeds</b>	cocklebur eastern black nightshade giant foxtail giant ragweed smartweeds yellow foxtail	green foxtail lambsquarters pennycress shepherd's purse velvetleaf wild mustard	common ragweed pigweeds
<b>Perennial weeds</b>	curly dock hoary alyssum yellow rocket	Canada thistle quackgrass and other grasses	dandelion white cockle

**Table 4-2a.** Seedling legume tolerance and herbicide effectiveness on weeds commonly found in establishing legumes seeded without a cover crop<sup>a</sup>

Herbicide	Labeled crops	Mode of action <sup>b</sup>	Crop stage (min. leaves)	Crop tolerance	Grasses			Broadleaves											Caution statement <sup>c</sup>
					Barnyardgrass	Foxtail spp.	Quackgrass	Common chickweed	Common lambsquarters	Common ragweed	Eastern black nightshade	Field Pennycress	Pigweed spp.	Shepherd's purse	Smartweed spp.	Velvetleaf	Wild mustard	Wild radish	
Brox 2EC	al	6	4	7	4	4	0	4	9	9	9	9	7	10	8	8	8	8	x
Butyrac 200	al, bf	4	0	8	0	0	0	4	9	9	6	6	7	8	4	9	7	6	x
Eptam 20G	al, bf, cl	8	PPI	7	9	9	5	7	7	7	7	4	8	4	4	8	5	5	x
Eptam 7E	al, bf, cl	8	PPI	7	9	9	5	7	7	7	7	4	8	4	4	8	5	5	x
Extreme <sup>c</sup>	al	2,9	2	9	10	10	9	10	9	10	10	10	10	10	9	9	10	10	x
Poast Plus	al, bf, cl	1	0	10	9	10	7	0	0	0	0	0	0	0	0	0	0	0	x
Prowl H2O	al	3	2	10	9	9	4	7	9	4	4	5	9	8	4	0	0	0	
Pursuit	al,cl	2	2	8	8	8	4	8	7	6	10	9	10	9	8	9	9	8	
Raptor	al	2	2	8	8	9	5	8	8	7	10	9	10	9	8	9	9	8	
Roundup PowerMAX <sup>c</sup>	al, bf, cl	9	0	10	10	10	9	10	9	10	10	10	10	10	9	9	10	10	x
Select 2EC	al, bf	1	0	10	9	10	8	0	0	0	0	0	0	0	0	0	0	0	x
Select Max	al, bf	1	0	10	9	10	8	0	0	0	0	0	0	0	0	0	0	0	x
Treflan TR-10	al	3	PPI	8	9	9	4	5	7	5	5	5	9	5	5	0	5	0	
Warrant	al	15	1	9	9	9	0	-	8	6	9	-	9	-	7	5	-	-	x

Abbreviations: al = alfalfa; bf = birdsfoot trefoil; cl = clover

Efficacy ratings: 10 = excellent; 8 = good; 6 = fair; 4 = poor; 0 = none; — = insufficient information

<sup>a</sup> Adapted from Extension publication Alfalfa Management Guide (NCR547), 2011.<sup>b</sup> Weed Science Society of America-approved group numbers for the corresponding herbicide mode of action.<sup>c</sup> Labels recommend application when alfalfa has 3-4 TL to remove non-transgenic alfalfa seedling.<sup>d</sup> If column is marked with an x, see Table 4-2b for caution statement.**Table 4-2b.** Cautionary statements for herbicides of commonly found weeds in establishing legumes seeded without a cover crop

Herbicide	Cautionary statement
Brox 2EC	Do not treat alfalfa stressed by moisture, insect injury, or other causes.
Butyrac 200	Note forage can't be fed of grazed for 60 days after application for new seedlings.
Eptam 20G	Do not apply if atrazine has been applied within 12 months.
Eptam 7E	Do not apply if atrazine has been applied within 12 months.
Extreme	If broadcasted, use only on Roundup Ready alfalfa varieties.
Poast Plus	Do not use flood jet nozzle tips.
Roundup PowerMAX	If broadcasted, use only on Roundup Ready alfalfa varieties.
Select 2EC	Do not use flood nozzle tips.
Select Max	Do not use flood nozzle tips.
Warrant	Applications can be made after alfalfa emergence through the 4 <sup>th</sup> trifoliate stage.

## Herbicides for establishing alfalfa

### Brox 2EC

**Active ingredient(s):** bromoxynil

**Rate:** 1.0-1.5 pt/a

**Adjuvants:** none.

**Minimum # of alfalfa true leaves:** 4

**Pest timing: POST.** Treat when annual broad-leaves are 2 inches or less in height or 1 inch in diameter and have no more than 4 leaves.

**Remarks:** Controls common broadleaf weeds in alfalfa in either direct seeding or with a companion crop. May not adequately control overwintered weeds. Significant alfalfa injury may occur if the temperature exceeds 70°F within 3 days after application. Several factors influence the injury potential of Butril. The most important are stage of alfalfa growth (seedlings with less than four trifoliate leaves are very sensitive), presence of atrazine and/or Eptam residues (enhance injury), temperature and relative humidity (hot, humid conditions present a greater risk than dry conditions), and other causes of stress. Do not treat alfalfa stressed by moisture shortage or excess, insect injury, or other causes. Use spray volumes of at least 20 gal/a, flat fan nozzles, and 30 psi pressure. It can be tank mixed with Pursuit to improve control of pigweed, chickweed, and nightshade. Alfalfa can be treated at the 2 trifoliate leaf stage if reduced rates of Butril (0.25-0.38 pt/a) are used. Butril can be applied to seedling alfalfa that has been underseeded with small grains as long as grains are not past the boot stage.

### Butyrac 200

**Active ingredient(s):** 2,4-DB amine

**Rate:** 1-3 qt/a

**Adjuvants:** none.

**Minimum # of alfalfa true leaves:** 0. Treat any time after emergence

**Pest timing: POST.** Treat when annual broadleaf weeds are 3 inches or less in height.

**Remarks:** Controls many annual broadleaf weeds but is weak on smartweed and mustards and does not control perennial weeds or grasses. Alfalfa should be actively growing and free of stress, and no rainfall should occur within 7-10 days to reduce risk of crop injury. Seedlings may show temporary stunting, particularly if higher rates are applied during hot, humid conditions. Butyrac can be tank mixed with Butril, Poast Plus, Pursuit, Raptor, or Select Max.

### Eptam 20G

**Active ingredient(s):** EPTC

**Rate:** 15 lb/a

**Adjuvants:** none.

**Minimum # of alfalfa true leaves:** NA. Apply to a smooth, dry seedbed just before planting and immediately incorporate to a depth of 2-3 inches to prevent herbicide loss through evaporation. Where possible, simultaneously apply and incorporate in one operation.

**Pest timing: PPI.**

**Remarks:** Provides good control of annual grasses and many annual broadleaf weeds. Use the lower rate on coarse-textured soils. Eptam is ineffective on peat or muck soils. Complete control of any perennial weed should not be expected. Temporary stunting of the small-seeded legume and sealing of the first leaves may occur. Injury is likely if Eptam is applied during cool wet weather, at high rates, or if it is poorly incorporated. Do not seed brome, fescue, ryegrass, orchardgrass, timothy, or small grain since these will be killed. Do not apply if atrazine has been applied within 12 months as severe injury may result. Eptam can be mixed with liquid fertilizer solution or impregnated onto dry fertilizer for simultaneous application.

### Eptam 7E

**Active ingredient(s):** EPTC

**Rate:** 2.25-4.5 pt/a

**Adjuvants:** none.

**Minimum # of alfalfa true leaves:** NA. Apply to a smooth, dry seedbed just before planting and immediately incorporate to a depth of 2-3 inches to prevent herbicide loss through evaporation. Where possible, simultaneously apply and incorporate in one operation.

**Pest timing: PPI.**

**Remarks:** Provides good control of annual grasses and many annual broadleaf weeds. Use the lower rate on coarse-textured soils. Eptam is ineffective on peat or muck soils. Complete control of any perennial weed should not be expected. Temporary stunting of the small-seeded legume and sealing of the first leaves may occur. Injury is likely if Eptam is applied during cool wet weather, at high rates, or if it is poorly incorporated. Do not seed brome, fescue, ryegrass, orchardgrass, timothy, or small grain since these will be killed. Do not apply if atrazine has been applied within 12 months as severe injury may result. Eptam can be mixed with liquid fertilizer solution or impregnated onto dry fertilizer for simultaneous application.

### Extreme

**Active ingredient(s):** imazethapyr + glyphosate

**Rate:** 2.2-4.4 pt/a

**Adjuvants:** NIS, AMS. Add 1 pt of nonionic surfactant + 8.5-17 lb/100 gal of ammonium sulfate. Adding other adjuvants (e.g., methylated seed oil) has the potential to increase crop injury and is not recommended.

**Minimum # of alfalfa true leaves:** 2

**Pest timing: POST.** Treat when annual weeds are 1-3 inches tall or rosettes are 1-3 inches wide.

**Remarks:** The combination of glyphosate and imazethapyr are effective at controlling most weed species encountered in seedling alfalfa in Wisconsin. The addition of the imazethapyr will provide residual control that glyphosate does not. Temperatures below 50°F can reduce effectiveness. Following application, plants may be temporarily stunted. Up to 10% of the purchased seed may not have the Round-up Ready gene; therefore, applying glyphosate when alfalfa has 3-4 trifoliate leaves is recommended to eliminate susceptible plants, regardless of weed populations.

### Poast Plus

**Active ingredient(s):** sethoxydim

**Rate:** 18-36 fl oz/a

**Adjuvants:** COC, DASH, SUNDANCE, N, AMS. Add 1 qt/a of a crop oil concentrate or 1 pt/a of Dash HC or Sundance HC for all Poast Plus applications.

**Minimum # of alfalfa true leaves:** 0

**Pest timing: POST.** Treat when annual grasses are 4-8 inches tall and actively growing and before the alfalfa gets large enough to reduce interception of the spray solution.

**Remarks:** Provides control of annual grasses in newly seeded alfalfa. For best control, treat before the first mowing. Apply Poast Plus in 5-20 gal/a of spray solution using 40-60 psi pressure. Do not use flood jet nozzle tips. Poast Plus can be tank mixed with Pursuit or Raptor to broaden the spectrum of weeds controlled. Poast Plus can also be applied to kill oats used as a temporary companion crop by an application when the oats are 4-6 inches tall.

### Prowl H2O

**Active ingredient(s):** pendimethalin

**Rate:** 1.1-2.1 pt/a

**Adjuvants:** none.

**Minimum # of alfalfa true leaves:** 2—Apply to seedlings when alfalfa has two or more trifoliate leaves but is less than 6 inches in height.

**Pest timing: PRE.** Will only control weeds that have not yet emerged

**Remarks:** Applications are effective at preventing the emergence of many small seeded grasses and broadleaf weeds, but used alone this product has limited value in weed control for alfalfa seedling

establishment in Wisconsin as many weeds have emerged before the 2<sup>nd</sup> true alfalfa leaf.

## Pursuit

**Active ingredient(s):** imazethapyr

**Rate:** 3-6 fl oz/a

**Adjuvants:** NIS, AMS, COC, MSO, N, AMS. In most situations the addition of a nonionic surfactant to the spray solution (1 qt/100 gal) is recommended. If weeds are large and growing conditions are dry, consider using a crop oil concentrate (5 qt/100 gal) or a methylated seed oil (4 qt/100 gal) instead of a surfactant. For all applications, also add 28% liquid nitrogen (1.25-2.5 gal/100 gal) or ammonium sulfate (12-15 lb/100 gal) to the spray solution.

**Minimum # of alfalfa true leaves:** 2

**Pest timing:** POST. Treat when annual weeds are 1-3 inches tall or rosettes are 1-3 inches wide.

**Remarks:** Controls many annual broadleaf and several annual grass weeds. Provides residual control of later emerging weeds up to a month after application. May be tank mixed with Buctril, Butyrac, Poast Plus, or Select Max to increase spectrum of weeds controlled. Injury can occur, especially if alfalfa plants are stressed and not actively growing. Delay applications for 48 hours when the air temperatures stay at or below 40°F for 10 or more hours. Following application, alfalfa may be temporarily stunted. Several weed species in Wisconsin have documented resistance to imidazolinone herbicides such as Pursuit. If applications appear to have not worked, please consult your local Extension agent for assistance in determining if you have a resistant population in your field.

## Raptor

**Active ingredient(s):** imazamox

**Rate:** 4-6 fl oz/a

**Adjuvants:** NIS, AMS, COC, MSO, N, AMS. In most situations the addition of a nonionic surfactant to the spray solution (1 qt/100 gal) is recommended. If weeds are large and growing conditions are dry, consider using a crop oil concentrate (1-2 gal/100 gal) or a methylated seed oil (1-2 gal/100 gal) instead of a surfactant. For all applications, also add 28% liquid nitrogen (2.5 gal/100 gal) or ammonium sulfate (12-15 lb/100 gal) to the spray solution.

**Minimum # of alfalfa true leaves:** 2

**Pest timing:** POST. Treat when annual weeds are 1-3 inches tall or rosettes are 1-3 inches wide.

**Remarks:** Controls many annual broadleaf and several annual grass weeds. Provides residual control of later emerging weeds up to a month after application. May be tank mixed with Buctril, Butyrac, Poast Plus, or Select Max to increase spectrum of weeds

controlled. Injury can occur, especially if alfalfa plants are stressed and not actively growing. Delay applications for 48 hours when the air temperatures stay at or below 40°F for 10 or more hours. Following application, alfalfa may be temporarily stunted. Several weed species in Wisconsin have documented resistance to imidazolinone herbicides such as Raptor. If applications appear to have not worked, please consult your local Extension agent for assistance in determining if you have a resistant population in your field. The primary differences between Raptor and Pursuit is that Raptor is more effective on common lambsquarters and annual grasses, has no preharvest interval, and has a shorter rotational interval for most vegetable crops.

## Roundup PowerMAX

**Active ingredient(s):** glyphosate

**Rate:** 22-44 fl oz/a

**Adjuvants:** NIS, AMS. Ammonium sulfate at 8.5-17 lb/100 gal of spray mixture is recommended if using hard water. Additional surfactant is rarely needed.

**Minimum # of alfalfa true leaves:** 0

**Pest timing:** POST. Treat when annual weeds are 4-6 inches tall and just prior to flowering for perennials.

**Remarks:** Glyphosate kills a wide range of grass and broadleaf weeds. Roundup Ready alfalfa has excellent tolerance to glyphosate. In Roundup Ready alfalfa, apply glyphosate when the weed population justifies treatment. In direct seedings, this occurs typically 30-40 days after seeding. If oats are planted as a temporary cover crop, apply glyphosate when oats are 4-6 inches tall to kill oats and weeds. Up to 10% of the purchased seed may not have the Roundup Ready gene; therefore, applying glyphosate when alfalfa has 3-4 trifoliate leaves is recommended, to eliminate susceptible plants, regardless of weed populations. Glyphosate product must have the supplemental label to be applied in Roundup Ready alfalfa.

## Select 2EC

**Active ingredient(s):** clethodim

**Rate:** 6-16 fl oz/a

**Adjuvants:** NIS, COC, MSO, AMS. In most situations the addition of a nonionic surfactant to the spray solution (1 qt/100 gal) is recommended. If weeds are large and growing conditions dry, consider using a crop oil concentrate at 1% vol/vol. If difficult-to-control grass species are present, consider adding 2.5-4.0 lb/a of ammonium sulfate to improve control.

**Minimum # of alfalfa true leaves:** 0 Treat any

time after emergence

**Pest timing:** POST. Treat when annual grasses are 2-6 inches tall and actively growing.

**Remarks:** Controls grasses during the establishment of alfalfa grown for hay, silage, green chop, or direct grazing. Apply in 5-20 gal/a of spray solution using 30-60 psi pressure. Do not use flood nozzle tips. To control volunteer cereals in summer-seeded alfalfa, treat in the late summer or early fall when the cereals are 4-6 inches tall. It can also be used to kill oats planted as a temporary companion crop by an application when the oats are 4-6 inches tall. It can be tank mixed with Pursuit or Butyrac in new seedings for broadleaf weed control but do not do so unless the feeding, grazing, and harvesting restriction on these labels can be observed.

## Select Max

**Active ingredient(s):** clethodim

**Rate:** 9-32 fl oz/a

**Adjuvants:** NIS, COC, MSO, AMS. In most situations the addition of a nonionic surfactant to the spray solution (1 qt/100 gal) is recommended. If weeds are large and growing conditions dry, consider using a crop oil concentrate at 1% vol/vol. If difficult-to-control grass species are present, consider adding 2.5-4.0 lb/a of ammonium sulfate to improve control.

**Minimum # of alfalfa true leaves:** 0 Treat any time after emergence

**Pest timing:** POST. Treat when annual grasses are 2-6 inches tall and actively growing.

**Remarks:** Controls grasses during the establishment of alfalfa grown for hay, silage, green chop, or direct grazing. Apply in 5-20 gal/a of spray solution using 30-60 psi pressure. Do not use flood nozzle tips. To control volunteer cereals in summer-seeded alfalfa, treat in the late summer or early fall when the cereals are 4-6 inches tall. It can also be used to kill oats planted as a temporary companion crop by an application when the oats are 4-6 inches tall. It can be tank mixed with Pursuit or Butyrac in new seedings for broadleaf weed control but do not do so unless the feeding, grazing, and harvesting restriction on these labels can be observed.

## Treflan TR-10

**Active ingredient(s):** trifluralin

**Rate:** 5.0-7.5 lb/A

**Adjuvants:** none.

**Minimum # of alfalfa true leaves:** NA. Apply prior to planting and incorporate within 24 hours to a depth of 2-3 inches

**Pest timing:** PPI.

**Remarks:** Provides control of annual grasses and

pigweed species, but has little effect on ragweed, velvetleaf, and weeds in the mustard family. Do not seed forage grasses such as orchardgrass with the alfalfa. It will not control quackgrass or wirestem muhly emerging from rhizomes. Select application rate based on soil texture (see supplemental label). It can be simultaneously applied with a liquid fertilizer or impregnated onto dry fertilizer.

## Warrant

**Active ingredient:** acetochlor

**Rate:** 1.25 – 2 quarts/a depending on soil organic matter and soil texture.

**Adjuvants:** None

**Minimum # of alfalfa true leaves:** 1 (apply after alfalfa emergence) to 4<sup>th</sup>-trifoliate leaf.

**Pest timing: PRE.** Will only control weeds that have not yet emerged.

**Remarks:** Applications are effective at preventing the emergence of most small seeded annual grass and broadleaf weeds for 1-2 months. Rainfall or irrigation is required after application to move the herbicide into the weed germination zone. May be tank-mixed with several POST herbicides, see label for details.

## Summer seedings

Most growers who seed alfalfa in the summer find that fewer weeds germinate at this time of the year and therefore preplant-incorporated herbicides are not needed. Summer annuals that germinate in late summer (velvetleaf, pigweed, crabgrass, and wild proso millet) typically do not grow very tall and die with the first frost. If ample soil moisture is present, treatment of these weeds is not needed if populations are low to moderate (<25% cover). If dry conditions occur, treatment is recommended to ensure acceptable stand establishment. If winter annuals (e.g. shepherd's purse, chickweed, and pennycress) are at moderate densities, treatment in the fall is warranted as they are hard to control the following spring. These weeds may reduce forage quality in the second year but rarely impact yield. If concerned about forage quality the spring after a summer seeding, we recommend scouting fields routinely every other week in October to see if a postemergence treatment is needed.

When summer seedings follow wheat, volunteer wheat is often a serious problem. This is less likely if fields are moldboard plowed before seeding alfalfa. When fields are disked, chisel plowed, or no-till seeded, winter wheat often germinates and competes with the alfalfa, especially the following spring. Volunteer wheat can reduce alfalfa densities and impact establishment if dense stands are present. If volunteer wheat threatens alfalfa establishment, make a fall application of Poast Plus, Select, glyphosate (Roundup Ready alfalfa only), or Raptor with an appropriate additive when wheat is 2-6 inches tall and actively growing. Delaying applications until late in the fall or the following spring will reduce success in control.

## Weed management in established forage legumes

Removing weeds from forage crops seldom increases total yield because the weeds are harvested along with the crop. However, since weeds are often less palatable, lower in protein, and less digestible than forages, controlling weeds can improve forage quality.

Some believe that weed control may prolong the productive life of forage stands by preventing competitive weeds, such as quackgrass and dandelions, from crowding out the forage. However, weeds seldom affect forage stand density in Wisconsin. Other factors have been found to play a more important role in determining stand life. These include cold winter temperatures, cutting schedule, and disease or insect problems.

Established stands of forage legumes compete effectively with many annual and perennial weeds. If weeds appear, inadequate soil fertility, low soil pH, poor soil drainage, plant diseases, too frequent of harvest, or other factors hampering legume growth may be the cause. Winter annual weeds, such as shepherd's purse, chickweed, and pennycress, may become a problem

if conditions the previous fall were suitable for their establishment. Some perennial weeds, such as white cockle, yellow rocket, dandelions, hoary alyssum, and quackgrass, persist despite legume competition. These weeds can be kept from spreading by harvesting the infested legume before weed seeds are produced. If seed does mature before the legume is ready for harvest, the forage should be ensiled as this will kill nearly all weed seeds.

Base herbicide selection decisions in established legumes on the weed species to be controlled and forage stand density. For alfalfa, treat only if the field has an average of 55 stems or a minimum of 4 crowns per square foot. For stands with fewer stems or crowns present, we recommend rotating to another crop. Use table 4-3 to help select the appropriate treatment for the weed complex found in each field.

## Herbicides for established alfalfa

### Butyrac 200

**Active ingredient(s):** 2,4-DB amine

**Rate:** 1.0-3.0 qt/a

**Adjuvants:** none.

**Maximum alfalfa height that can be treated (inches):** 3

**Pest timing: POST.** Treat when annual broadleaves are less than 3 inches tall or wide.

**Remarks:** Controls common broadleaf weeds in alfalfa. May not adequately control overwintered weeds. Alfalfa should be healthy and actively growing for greatest crop safety. Significant alfalfa injury may occur if the temperature will exceed 90°F up to 3 days after application. Some stem twisting and malformation may occur, but plants usually outgrow these symptoms.

### Chateau

**Active ingredient(s):** flumioxazin

**Rate:** 4 oz/a

**Adjuvants:** none. See remarks

**Maximum alfalfa height that can be treated (inches):** 6

**Pest timing: PRE.** Make applications before emergence of target weed species as Chateau has only

preemergence activity on germinating weed seeds.

**Remarks:** Can be impregnated onto dry fertilizer for simultaneous application. Do not add any adjuvant or product formulated as an emulsified concentrate (EC). Addition of adjuvant or tank mixing with an EC product will cause Chateau to also exhibit postemergence activity similar to a contact herbicide. While control of emerged annual weeds can result, damage will occur to alfalfa if it has resumed growth. Alfalfa plants may be stunted and have reduced yield in the harvest after application.

## Extreme

**Active ingredient(s):** imazethapyr + glyphosate

**Rate:** 2.2-4.4 pt/a

**Adjuvants:** NIS, AMS. Add 1 pt of nonionic surfactant + 8.5-17 lb/100 gal of ammonium sulfate. Adding other adjuvants (e.g. methylated seed oil) has the potential to increase crop injury and is not recommended.

**Maximum alfalfa height that can be treated (inches):** 3

**Pest timing:** PRE, POST. Treat when annual weeds are 1-3 inches in height or diameter.

**Remarks:** The combination of glyphosate and imazethapyr are effective at controlling most weed species encountered in established alfalfa in Wisconsin. The addition of the imazethapyr will provide residual control that glyphosate does not, thus preventing the germination of many annual weeds. Temperatures below 50°F can reduce effectiveness. Following application, plants may be temporarily stunted.

## Metribuzin

**Active ingredient(s):** metribuzin

**Rate:** 0.33-1.33 lb/a

**Adjuvants:** none.

**Maximum alfalfa height that can be treated (inches):** 3

**Pest timing:** PRE, POST. Treat before weeds have emerged or are less than 2 inches in height or diameter

**Remarks:** Is effective on annual and perennial weeds in pure alfalfa stands and when mixed with forage grasses. Use lower rates on sandy loam and loamy sand soils, but do not apply on sandy soils. Expect some injury to forage grasses after application if present. Stresses such as drought, disease, low fertility, overcutting, or insects may increase the likelihood of alfalfa injury. Metribuzin can be impregnated onto dry fertilizer for simultaneous application. Do not apply if the alfalfa stand density is below threshold, as yields will be reduced.

## Poast Plus

**Active ingredient(s):** sethoxydim

**Rate:** 18-36 fl oz/a

**Adjuvants:** COC, DASH, SUNDANCE, N, AMS. Add 1 qt/a of a crop oil concentrate or 1 pt/a of Dash HC or Sundance HC for all Poast Plus applications.

**Maximum alfalfa height that can be treated (inches):** any

**Pest timing:** POST. Treat when annual grasses are 4-8 inches tall and actively growing and before the alfalfa gets large enough to reduce interception of the spray solution.

**Remarks:** Effective at suppressing perennial grasses when applied before first cutting or used in the summer to control annual grasses that appear following the second or third cutting. Forage grasses, if present will be stunted or killed. Control will be reduced if grassy weeds are under stress, especially from drought, or if they have been previously mowed. Use 40-60 psi pressure, 5-20 gal/a spray solution, and flat fan or hollow cone nozzles to apply.

## Prowl H2O

**Active ingredient(s):** pendimethalin

**Rate:** 1.1-4.2 qt/a

**Adjuvants:** none.

**Maximum alfalfa height that can be treated (inches):** 6

**Pest timing:** PRE. Will only control weeds that have not yet emerged

**Remarks:** Effective at preventing the emergence of many small seeded grasses and broadleaf weeds and a good fit for thinning stands with annuals weeds. Its effectiveness on winter annuals is variable unless rates greater than 2 qt/a are utilized.

## Pursuit

**Active ingredient(s):** imazethapyr

**Rate:** 3-6 fl oz/a

**Adjuvants:** NIS, AMS, COC, MSO, N, AMS. In most situations the addition of a nonionic surfactant to the spray solution (1 qt/100 gal) is recommended. If weeds are large and growing conditions are dry, consider using a crop oil concentrate (5 qt/100 gal) or a methylated seed oil (4 qt/100 gal) instead of a surfactant. For all applications, also add 28% liquid nitrogen (1.25-2.5 gal/100 gal) or ammonium sulfate (12-15 lb/100 gal) to the spray solution.

**Maximum alfalfa height that can be treated (inches):** 3

**Pest timing:** PRE, POST. Apply in the spring or fall to annual weeds that have not yet emerged or are 1-3 inches in height or diameter.

**Remarks:** Effective in suppressing annual weeds, but not perennial weeds in pure alfalfa stands and

when mixed with forage grasses. Expect some injury to forage grasses after application. Good herbicide coverage is essential for adequate weed control; weeds treated after a recent harvest may be inadequately controlled. Several weed species are resistant to imidazolinone herbicides such as Pursuit. If applications appear to have not worked, please consult your local Extension agent for assistance in determining if you have a resistant population in your field.

## Raptor

**Active ingredient(s):** imazamox

**Rate:** 4-6 fl oz/a

**Adjuvants:** NIS, AMS, COC, MSO, N, AMS. In most situations the addition of a nonionic surfactant to the spray solution (1 qt/100 gal) is recommended. If weeds are large and growing conditions are dry, consider using a crop oil concentrate (1-2 gal/100 gal) or a methylated seed oil (1-2 gal/100 gal) instead of a surfactant. For all applications, also add 28% liquid nitrogen (2.5 gal/100 gal) or ammonium sulfate (12-15 lb/100 gal) to the spray solution.

**Maximum alfalfa height that can be treated (inches):** 3

**Pest timing:** PRE, POST. Apply in the spring or fall to annual weeds that have not yet emerged or are 1-3 inches in height or diameter.

**Remarks:** Effective in suppressing annual weeds, but not perennial weeds in pure alfalfa stands. Good herbicide coverage is essential for adequate weed control; weeds treated after a recent harvest may be inadequately controlled. Several weed species are resistant to imidazolinone herbicides such as Raptor. If applications appear to have not worked, please consult your local Extension agent for assistance in determining if you have a resistant population in your field.

## Roundup PowerMAX

**Active ingredient(s):** glyphosate

**Rate:** 22-42 fl oz/a

**Adjuvants:** AMS. AMS at 8.5-17 lb/100 gallons of spray mixture is recommended if using hard water. Additional surfactant is rarely needed.

**Maximum alfalfa height that can be treated (inches):** any (up to 5 days before cutting)

**Pest timing:** POST. For perennial weeds, fall applications will give the best results. Quackgrass can be controlled with either spring or fall applications. Apply to annual weeds when they are 4-6 inches tall.

**Remarks:** Provides good to excellent control of most grass and broadleaf weeds found in established alfalfa fields in Wisconsin. Fall applications are recommended to control winter annual or

perennial weeds. For removal of Roundup Ready alfalfa use at least 1.0 lb ae/a of either 2,4-D or dicamba or a combination of both in the fall prior to a hard frost. Also scout and plan for management of volunteer plants in the crop the following year, especially in no-till fields.

### Select 2EC

**Active ingredient(s):** clethodim

**Rate:** 10-16 fl oz/a

**Adjuvants:** NIS, COC, MSO, AMS. In most situations the addition of a nonionic surfactant to the spray solution (1 qt/100 gal) is recommended. If weeds are large and growing conditions dry, consider using a crop oil concentrate or methylated seed oil at 0.25% vol/vol. If difficult-to-control grass species are present, consider adding 2.5-4.0 lb/a of ammonium sulfate to improve control.

**Maximum alfalfa height that can be treated (inches):** any

**Pest timing:** POST.

**Remarks:** Effective at suppressing perennial grasses when applied before first cutting or used in the summer to control annual grasses that appear following the second or third cutting. Forage grasses, if present will be stunted or killed. Control will be reduced if grassy weeds are under stress, especially from drought, or if they have been previously mowed.

### Select Max

**Active ingredient(s):** clethodim

**Rate:** 12-32 fl oz/a

**Adjuvants:** NIS, COC, MSO, AMS. In most situations the addition of a nonionic surfactant to the spray solution (1 qt/100 gal) is recommended. If weeds are large and growing conditions dry, consider using a crop oil concentrate or methylated seed oil at 0.25% vol/vol. If difficult-to-control grass species are present, consider adding 2.5-4.0 lb/a of ammonium sulfate to improve control.

**Maximum alfalfa height that can be treated (inches):** any

**Pest timing:** POST. Treat when annual grasses are 2-6 inches tall and when perennials are 4-8 inches tall.

**Remarks:** Effective at suppressing perennial grasses when applied before first cutting or used in the summer to control annual grasses that appear following the second or third cutting. Forage grasses, if present, will be stunted or killed. Control will be reduced if grassy weeds are under stress, especially from drought, or if they have been previously mowed.

### Velpar 2L

**Active ingredient(s):** hexazinone

**Rate:** 1-6 pt/A

**Adjuvants:** NIS, COC, MSO. If weeds have emerged use a surfactant approved for crops at 0.25 % v/v (1 qt/100 gallons)

**Maximum alfalfa height that can be treated (inches):** 2

**Pest timing:** PRE, POST. Apply before weed emergence for best results.

**Remarks:** Effective at suppressing perennial weeds in established alfalfa. Use no more than 1 lb/a of Velpar in stands less than 12 months old. Select rate based on % organic matter and soil texture (see label). Do not treat stressed stands or alfalfa-grass mixtures. Do not use in sandy soils, poorly drained soils, or exposed subsoil areas. May be mixed with dry bulk fertilizer for simultaneous application. Use at least 20 gal/A of spray solution to apply. Do not apply if the alfalfa stand density is below threshold, as yields will be reduced.

### Velpar 75DF

**Active ingredient(s):** hexazinone

**Rate:** 0.67-2.0 lb/a

**Adjuvants:** none.

**Maximum alfalfa height that can be treated (inches):** 2

**Pest timing:** PRE, POST. Treat before weeds have emerged for the best results.

**Remarks:** Effective at suppressing perennial weeds in established alfalfa. Use no more than 1 lb/a of Velpar in stands less than 12 months old. Use lower rates (0.67-1.0 lb/a) on coarse to medium soils and higher rates (1-2 lb/a) on medium to heavy soils with 1-5% organic matter. Do not treat stressed stands or alfalfa-grass mixtures. Do not use in sandy soils, poorly drained soils, or exposed subsoil areas. Velpar may be mixed with dry bulk fertilizer for simultaneous application. Use at least 20 gal/a of spray solution to apply. Do not apply if the alfalfa stand density is below threshold, as yields will be reduced.

### Warrant

**Active ingredient:** acetochlor

**Rate:** 1.25 – 2 quarts/a depending on soil organic matter and soil texture.

**Adjuvants:** none

**Maximum alfalfa height:** NA, after spring green-up or no later than 7 days between cuttings.

**Pest timing:** PRE. Will only control weeds that have not yet emerged.

**Remarks:** Applications are effective at preventing the emergence of most small seeded annual grass and broadleaf weeds for 1-2 months. Rainfall or

irrigation is required after application to move the herbicide into the weed germination zone. Remove any previous cut forage before making applications. May be tank-mixed with several POST herbicides, see label for details.

## Weed and brush control in grass pastures

Proper fertilization, grazing, and weed management all play an important role in good pasture management. Low soil fertility or excessive grazing allows weeds to invade. Several weed management options exist in pastures, although initially producers should ensure pasture management is being conducted properly.

Most producers rely on mowing, grazing, or herbicides. Mowing and grazing can be effective management strategies at preventing further spread of perennial weeds and reducing populations of annual and biennial weeds. Success is dependent on mowing at the correct stage of development to maximize injury to the weed species and promote forage growth. Timings for mowing and grazing are species-specific, but typically plants should be mowed just as the flowers begin to open. Annuals and biennial weeds usually don't die, but many don't regrow enough to produce viable seed. If this practice can be repeated for 3-5 years at the correct stage of development, weed populations can be dramatically reduced. Perennial plants have enough energy to regrow and produce viable seed and often need to be mowed multiple times to prevent seed production. Similar results can be obtained with grazing, but the palatability of weeds, especially at the appropriate stage of development, may reduce injury to the weeds and result in reduced control.

While mowing and grazing are effective management strategies, herbicides are usually more effective and less expensive. In addition, several herbicides or herbicide combinations can be used to control unwanted brush in pastures. Which herbicide to

**Table 4-3a.** Legume tolerance and herbicide effectiveness on weeds commonly found in established legume stands

Herbicide	Site of action group <sup>a</sup>	Weed timing	Labeled crops	Crop tolerance	Annual weeds				Perennial weeds										Caution statement <sup>c</sup>		
					Common chickweed	Field pennycress	Foxtail species	Shepherd's purse	Broadleaf plantain	Canada thistle	Comon Dandelion	Curly dock	Hemp dogbane	Hoary alyssum	Perennial sowthistle	Quackgrass	White cockle	Wirestem muhly		Yellow nutsedge	Yellow rocket
Butyrac 200	4	POST	al	8	4	7	0	7	7	4	4	5	0	6	4	0	4	0	0	4	
Chateau	14	PRE	al	8	10	10	9	10	—	4	4	4	—	4	—	4	4	—	4	4	
Extreme	2, 9	POST	al	9	10	10	10	10	9	4	8	5	4	6	9	9	7	9	7	9	x
Metribuzin	5	PRE or POST	al	7	10	9	6	10	4	4	9	6	4	7	4	7	8	4	6	8	x
Poast Plus	1	POST	al, bf	10	0	0	10	0	0	0	0	0	0	0	0	7	0	7	0	0	
Prowl H2O	3	PRE	al	10	4	4	9	7	4	4	4	4	4	4	—	4	4	—	4	4	
Pursuit	2	PRE or POST	al, bf <sup>b</sup>	8	8	10	7	9	6	4	4	5	4	6	8	4	4	4	5	7	
Raptor	2	PRE or POST	al, cl	8	8	10	9	9	6	5	5	5	—	6	8	5	4	4	6	7	
Roundup PowerMAX	9	POST	al, bf, cl	10	10	10	10	10	9	8	8	—	9	—	9	9	7	9	7	9	x
Select 2EC	1	POST	al, bf	10	0	0	10	0	0	0	0	0	0	0	0	8	0	7	0	0	
Select Max	1	POST	al, bf	10	0	0	10	0	0	0	0	0	0	0	0	8	0	7	0	0	
Velpar 75DF	5	PRE	al	8	10	9	6	10	7	0	9	6	0	8	4	7	6	6	6	9	x
Velpar 2L	5	PRE	al	8	10	9	6	10	7	0	9	6	0	8	4	7	6	6	6	9	x
Warrant	al	15	1	9	-	-	9	-	0	0	0	0	0	0	0	0	0	0	7	0	x

Abbreviations: al = alfalfa; bf = birdsfoot trefoil; cl = clover

Efficacy ratings: 10 = excellent; 8 = very good; 6 = good; 4 = fair; 2 = poor; 0 = no control; — = no information

Crop tolerance ratings: 10 = excellent; 8 = good; 6 = fair

<sup>a</sup> Weed Science Society of America-approved group numbers for the corresponding herbicide site of action.<sup>b</sup> Labeled for use only when these species are used as a cover crop.<sup>c</sup> If column is marked with an x, see Table 4-3b for caution statement.**Table 4-3b.** Cautionary statements for herbicides of commonly found weeds in established legume stands

Herbicide	Caution statement
Extreme	If broadcasted, use only on Roundup Ready alfalfa varieties.
Metribuzin	Do not apply on sandy soils.
Roundup PowerMAX	If broadcasted, use only on Roundup Ready alfalfa varieties.
Velpar 75DF	Do not use in sandy soils, poorly drained soils, or exposed subsoil areas.
Velpar 2L	Do not use in sandy soils, poorly drained soils, or exposed subsoil areas.
Warrant	Applications can be made before alfalfa spring green-up and between cuttings but no later than 7 days after alfalfa is cut.

use will depend upon the susceptibility of the most prevalent weeds in the pasture (see table 4-4). Recommended rates of herbicides typically do not damage forage grasses but will injure or kill existing forage legumes, such as clovers and birdsfoot trefoil. If these legumes are desirable, avoid using herbicides or spot treat to minimize herbicide contact with these plants.

Herbicides labeled for pastures are not harmful to livestock when properly applied. However, treatment of poisonous weeds may make these species more palatable to grazing livestock or cause accumulation of toxic substances in poisonous weeds. As a general recommendation, do not graze treated pastures for 2 weeks after application. Otherwise, follow the grazing restrictions as described on the herbicide label. We also suggest a 2-week interval without grazing before applying herbicides in pastures. This will help ensure that the weeds are not stressed from grazing and trampling when treated.

For details about the effectiveness of herbicides registered for use on invasive weeds growing in CRP fields, refer to table 8-3 in the Appendix.

## 2,4-D for herbaceous weed control

**Rate:** Apply 2 pt/a of 2,4-D amine or ester (forms containing 3.8 lb ae/gal) to control annual broadleaf weeds, 2-4 pt/a to control biennials and perennial broadleaves.

**Adjuvants:** Do not add surfactants or other additives to the spray mixture.

**Timing: POST.** Treat annual broadleaves when they are less than 6 inches tall; biennials like bull, musk, and plumeless thistles in the rosette stage; and actively growing perennial broadleaf weeds in the bud stage or fall.

**Remarks:** Application of 2,4-D amine or ester will effectively control most nonwoody broadleaf weed populations in grass pastures if applied at the correct stage. Fall or spring applications control biennial thistles in the rosette stage but after the biennials have formed a flower stalk, they are more tolerant to these herbicides. Several years of treatment may be necessary to satisfactorily control hard-to-kill perennial weeds.

The 2,4-D amines are water-soluble liquids and 2,4-D esters are emulsifiable concentrates. Both

formulations are sold under various trade names and at various concentrations of ae/gal. Ester formulations have greater potential to volatilize and drift than amine formulations. Read the label carefully to avoid application during conditions that will promote vapor drift. Formulations of 2,4-D ester are also available in low-volatile forms that reduce the potential for vapor drift. 2,4-D will injure or even kill forage legumes such as clover and trefoil. Wait 2 weeks per pint of 2,4-D applied per acre before reseeding pasture species or injury may occur.

Most labels state that pastures treated with 2,4-D should not be grazed by dairy cattle for 7 days after treatment and that meat animals must be removed from treated areas 3 days before slaughter unless more than 2 weeks have elapsed since treatment. Do not cut treated grass for hay within 30 days after application. As many products exist, read the label carefully for specific rates, grazing restrictions, and application precautions.

## 2,4-D for brush control

**Rate:** Varies with brush species and method of application. See label for details.

**Adjuvants:** Do not add surfactants or other additives to the spray mixture.

**Timing: POST.** Apply 2,4-D in late spring or early summer when brush species have a full leaf canopy that is actively growing.

**Remarks:** With foliar sprays, wet foliage to the point of runoff. 2,4-D alone is not effective on all brush species. Some retreatment is usually required for complete kill. Cut brush that is more than 6-8 ft tall and treat the cut surface or regrowth the following year. See remarks above under herbaceous control for more information.

## Banvel/Clarity

See dicamba.

## Chaparral

**Active ingredient(s):** aminopyralid + metsulfuron

**Rate:** 1.0-2.0 oz/a for annual and biennial weeds and 2.5-3.3 oz/a for difficult-to-control perennials and brush species. Consult the label for rates for specific weed species.

**Adjuvants:** Add either a nonionic surfactant at 0.25-0.50% vol/vol, a crop oil concentrate at 1-2% vol/vol, or a methylated seed oil at 0.50% vol/vol.

**Timing: POST.** Although Chaparral is effective when applied across a range of plant stages, best results are observed if annual weeds are treated when they are less than 6 inches tall, biennial weeds as rosettes, and perennials at the flower bud

to flowering stages. If perennial plants are mowed in the summer, resprouting plants can be treated in the fall as long as leaves are green. Brush can be treated from the spring through the fall as long as it has leaves present that are green and it is actively growing.

**Remarks:** The combination of aminopyralid and metsulfuron make this product active on nearly all broadleaf weeds and brush species found in Wisconsin pastures. This herbicide is active on legumes and can prevent any growing legume for one or more years in pastures. Soil activity of both aminopyralid and metsulfuron can last for months to years depending on the rate applied and environmental conditions. Research in Wisconsin has shown successful establishment of legumes one year after application, but the label recommends conducting a soil bioassay before planting. Since this product contains aminopyralid, users must ensure that manure created from animals that feed on treated hay is not put onto a field that will be planted to any broadleaf crop (see label for more information). Animals should be fed aminopyralid-free forage for at least 3 days before they are transferred to a field with sensitive plants (such as clovers). Treated areas can be harvested or grazed any time after application, but it is recommended to wait 14 days after treatment. If treated pastures are hayed, forage cannot be sold for 18 months after treatment and must be used on-farm.

## Crossbow

**Active ingredient(s):** triclopyr + 2,4-D ester

**Rate:** For most brush species use 1.5 gal/a when broadcast spraying, or 1.0-1.5% (vol/vol) mixture for foliar applications to single plants or small areas. The broadcast rate varies from 1-4 qt/a for herbaceous broadleaf weeds. Check the label for the rate to use on specific weeds.

**Timing: POST.** Plants must be fully leafed out and actively growing when treated with foliar applications. Crossbow can also be applied as a cut surface treatment.

**Remarks:** Crossbow is a prepackaged mix of triclopyr and 2,4-D ester that controls many herbaceous and brush weeds including alder, ash, burdock, wild carrot, cherry, goldenrod, multiflora rose, sumac, and willow. It can be applied with conventional boom sprayers as a broadcast treatment, as a foliar spray to individual brush plants, or as a cut surface treatment. Crossbow is formulated to have low volatility, but applications should be avoided when temperatures are over 90°F and humidity is low. Follow label precautions to prevent spray or vapor drift to sensitive vegetation.

Do not graze lactating dairy cows in treated

pastures until the next growing season. Do not harvest hay for 14 days after treatment. While there is no grazing restriction for other livestock, we recommend a 14-day removal period. If livestock will be slaughtered in the year of treatment, remove the animals from these pastures at least 3 days before slaughter.

## Curtail

**Active ingredient(s):** clopyralid + 2,4-D

**Rate:** 2-6 pt/a. Use lower rates on annual and biennial weeds and higher rates on Canada thistle.

**Adjuvants:** Adjuvants are not normally needed with Curtail.

**Timing:** Treat biennial weeds when they are in the rosette growth stage. Treat perennials when the basal leaves are fully developed and up to the bud stage. Later applications to perennials may also be done if soil moisture is adequate and plants are actively growing.

**Remarks:** Curtail contains 0.38 lb ae of clopyralid and 2.0 lb ae of 2,4-D per gallon. Both active ingredients are formulated as amines. Thus, there is lower risk of vapor drift with Curtail. When applied at 4 to 6 pt/a, Curtail gives the same amount of clopyralid as 8-12 fl oz of Stinger and the same amount of 2,4-D as 1.0-1.5 qt of 2,4-D (products with 3.8 lb ae/gal).

The primary use of Curtail in pastures will be to control thistles and spotted knapweed. Curtail is not an effective brush herbicide. The label recommends the 4 pt/a rate for light to moderate Canada thistle and knapweed infestations when plants are actively growing and 6 pt/a for dense infestations or when dry weather or other stresses have reduced the growth of Canada thistles. For biennial thistles, use 2 pt/a when plants are in the rosette stage and 3 pt/a if bolting has occurred but before plants reach the bud stage.

For best results, treat when weeds are actively growing. Drought, heat, and cold stress may reduce weed control and increase crop injury. The grazing restriction for lactating dairy cattle is 14 days. Animals must be removed from treated pastures before being slaughtered unless 2 weeks has passed since treatment. If animals are to be moved into areas with sensitive broadleaf plants, feed animals untreated forage for at least 7 days before moving them. While there is no grazing restriction for other livestock, we suggest a 14-day interval for all animals. Grass hay cannot be harvested for 14 days after application. Curtail is rainfast within 6 hours after application.

## dicamba

**Rate:** Apply 0.5-1.0 pt/a Banvel or Clarity to control weeds such as wild buckwheat, chickweed, chicory,

curly dock, common ragweed, giant ragweed, redroot pigweed, shepherd's purse, and velvetleaf. The 1 pt/a rate burns down the top growth of field bindweed, Canada thistle, perennial sowthistle, and leafy spurge. Rates of 1 qt/a will control weeds such as wild carrot, goldenrod, knapweed, and yarrow. Broadcast applications cannot exceed 1 qt/a.

**Adjuvants:** Including a nonionic surfactant at 0.25-0.50% (vol/vol) of spray solution can provide additional control, particularly for difficult-to-control weeds.

**Timing: POST.** Apply dicamba to young, actively growing weeds before they bloom. If perennials regrow, treat as needed. In newly seeded grass pastures, do not apply dicamba until the grasses have three to five leaves.

**Remarks:** Dicamba controls many hard-to-kill broadleaf weeds and several brush species. Follow label directions and adjust application rates according to the weeds that need to be controlled. High rates of dicamba may cause temporary injury to sensitive pasture grasses. Avoid drift of dicamba onto desirable plants or crop injury will occur.

Soybeans, tobacco, vegetable crops, and many ornamentals are particularly sensitive to dicamba. Pastures treated with up to 1 pt/a of dicamba should not be grazed by dairy animals for 7 days or harvested for hay for 37 days after treatment. Pastures treated with up to 1 qt/a should not be grazed by dairy animals for 21 days or harvested for hay for 51 days after treatment. Pastures treated with 1-2 qt/a of dicamba should not be grazed by dairy animals for 40 days or harvested for hay for 70 days after treatment. There is no waiting period between treatment and grazing for non-lactating animals, but a 14-day period is suggested. Meat animals should not graze in treated pastures 30 days before slaughter.

## DuraCor

**Active ingredient(s):** aminopyralid + florypyrauxifen

**Rate:** 12-20 fl oz/a for herbaceous weeds. Consult the label for rates for specific weed species.

**Adjuvants:** Add either a high quality methylated seed oil at 1.0% vol/vol. or a nonionic surfactant (at least 80% active ingredient) at 0.25-0.50% vol/vol. This addition will enhance activity under stressful environmental conditions, when weeds are more mature than label recommendations, or are highly pubescent (hairy).

**Timing: POST.** Although DuraCor is effective when applied across a range of plant stages, best results are observed if annual weeds are treated when they are less than 6 inches tall, biennial weeds as rosettes, and perennials at the flower bud to flowering stages. If perennial plants are mowed

in the summer, resprouting plants can be treated in the fall as long as leaves are green. It does have activity on some brush species; applications should be applied when leaves are present, green and actively growing. Mixing in other active ingredients may help control (see label).

**Remarks:** The combination of aminopyralid and florypyrauxifen make this an effective herbicide on nearly all broadleaf weeds found in Wisconsin pastures. This herbicide is active on legumes and can suppress any growing legume for one or more years. Soil activity of aminopyralid can last for months to years depending on the rate applied and environmental conditions. Research in Wisconsin has shown successful establishment of legumes one year after application, but the label recommends conducting a soil bioassay before planting. Since this product contains aminopyralid, users must ensure that manure created from animals that feed on treated hay is not put onto a field that will be planted to any broadleaf crop (see label for more information). Animals should be fed aminopyralid-free forage for at least 3 days before they are transferred to a field with sensitive plants (such as clovers). Treated areas can be harvested or grazed any time after application, but it is recommended to wait 14 days after treatment. If treated pastures are hayed, forage cannot be sold for 18 months after treatment and must be used on-farm.

## Escort

**Active ingredient(s):** metsulfuron

**Rate:** Rates vary between 0.1 and 1.0 oz/a depending upon targeted weed species. Apply 0.3 – 0.5 oz/a as a broadcast treatment to control multiflora rose. Rates of 0.1-0.3 oz/a control wild carrot, musk thistle, buttercup, and curly dock. For spot treatments, mix 1 oz of product/100 gal of water (plus surfactant) and wet foliage to the point just before runoff. Higher rates (0.5-1.0 oz/a) are recommended to control difficult weed species. (see label.)

**Adjuvants:** Add a nonionic surfactant at 0.5-1.0 qt/100 gal of spray solution.

**Timing: POST.** Treat multiflora rose soon after the bushes are fully leafed out and other weeds when they are in the rosette to bud growth stages and actively growing, or in the fall to resprouting green tissue.

**Remarks:** Escort controls blackberries, bull and plumeless thistles, burdock, chickweed, dandelion, horsenettle, mullein, multiflora rose, plantain, wild parsnip, and yarrow. Thorough coverage of leaves and stems assures best results but avoid over-application or grass injury will occur. Symptoms in treated weeds begin to appear 2-3 weeks after application. If desired, this product can be tank

**Table 4-4.** Herbicide effectiveness on weeds commonly found in pastures<sup>a</sup>

Herbicide	Biennials						Perennials												
	Burdock	Carrot, wild	Parsnip, wild	Thistle, bull	Thistle, musk	Thistle, plumeless	Blackberry spp.	Buttercup spp.	Chickweed, giant	Chicory	Dock spp.	Goldenrod spp.	Horsenettle	Knapweed, spotted	Milkweed, common	Nettle, stinging	Rose, multiflora	Sowthistle, perennial	Thistle, Canada
2,4-D	9	9	9	9	9	9	6	6	4	9	7	7	4	6	4	7	5	4	6
Chaparral	9	10	10	10	10	10	8	10	9	10	9	9	8	10	4	8	9	9	10
Crossbow	9	8	8	9	9	9	8	8	8	7	9	7	8	7	6	9	8	7	6
Curtail	8	8	8	9	8	9	—	—	—	8	6	6	—	8	4	6	—	8	8
Dicamba	8	8	6	9	9	9	6	8	7	7	7	7	6	8	6	6	7	7	6
DuraCor	9	9	9	10	10	10	—	10	—	—	9	—	10	10	—	—	—	9	10
Escort	9	10	10	8	9	9	8	10	9	10	9	9	8	6	0	—	9	6	7
Glyphosate	8	9	9	9	9	9	8	9	9	9	9	8	8	9	8	9	8	8	9
GrazonNext HL	9	8	8	9	10	9	6	10	—	—	9	7	10	10	—	8	7	9	9
Milestone	9	6	6	10	10	10	6	10	—	—	8	5	10	10	—	8	6	9	10
PastureGard HL	9	7	—	7	7	7	7	7	—	8	7	8	5	5	6	9	8	—	5
Remedy Ultra	9	8	7	8	8	8	8	8	8	8	9	8	6	7	7	9	8	7	6
Stinger	9	4	6	9	9	9	4	—	—	9	8	4	0	9	4	4	4	6	9
Weedmaster	8	9	9	9	9	9	7	8	7	9	9	8	8	9	7	8	6	7	7

Efficacy ratings: 10 = excellent; 8 = good; 6 = fair; 4 = poor; 0 = none; — = insufficient information

<sup>a</sup> This summary table is based on observations in Wisconsin and other North Central states.

mixed with 2,4-D, Banvel, or Weedmaster.

Apply Escort in 10 gal/a or more of water within 24 hours of preparation or product degradation may occur. Do not use more than 40 psi when applying and do not use hollow cone nozzles. Make only one application per year. Follow all label directions to avoid spray drift and for sprayer cleanup after application.

There is no grazing restriction following application, even for lactating dairy animals. Nevertheless, a 14-day removal period is suggested.

Smooth brome, bluegrass, orchardgrass, and timothy are tolerant of Escort if they have been established for 6 months or more. Fescue should be established for at least 24 months before applications, and seedhead suppression may occur if applied in spring. Do not use these products in pastures containing meadow fescue or perennial ryegrass. Forage legumes are sensitive to metsulfuron and are injured and sometimes killed if treated; therefore, avoid broadcasting treatments if these legumes are desired.

### GrazonNext HL

**Active ingredient(s):** aminopyralid + 2,4-D

**Rate:** 19-34 fl oz/a. If spot treating, up to 67 fl oz/a may be applied IF no more than half the acre is sprayed.

**Adjuvants:** A nonionic surfactant is recommended at 0.25-0.5% (vol/vol).

**Timing: POST.** Best results are observed if annual weeds are treated when they are < 6 inches tall, biennial weeds as rosettes, and perennials at the flower bud to flowering stages. If perennial plants are mowed in the summer, resprouting plants can be treated in the fall as long as leaves are green.

**Remarks:** Aminopyralid in combination with 2,4-D results in effective control of most broadleaf weeds found in Wisconsin. Soil activity of aminopyralid lasts for several months; if applied in the fall, it can persist into the next year. Research in Wisconsin has shown successful establishment of legumes one year after application, but the label recommends conducting a soil bioassay before planting. Users must ensure that manure created from animals that

feed on treated hay is not put onto a field that will be planted to any broadleaf crop (see label for more information). Animals should be fed aminopyralid-free forage for three days before they are transferred to a field with sensitive plants (such as clovers). Treated areas should not be harvested for 7 days after application. If treated pastures are hayed, forage cannot be sold for 18 months after treatment and must be used on-farm.

### Milestone

**Active ingredient(s):** aminopyralid

**Rate:** 3-7 fl oz/a. Use lower rates for biennial thistles and higher rates for perennials like Canada thistle. If spot treating, up to 14 fl oz/a may be applied IF less than 50% of the area is treated.

**Adjuvants:** For postemergence applications, a nonionic surfactant should be added at 0.25-0.5% (vol/vol).

**Timing: POST.** Best results are observed if annual weeds are treated when they are small, biennial weeds as rosettes, and perennials at the flower bud

to flowering stages. If perennial plants are mowed in the summer, resprouting plants can be treated in the fall as long as leaves are green.

**Remarks:** This herbicide is particularly active on plants in the sunflower (thistles, knapweeds) and bean (legumes) families, but many broadleaf plants are tolerant, and established grasses are very tolerant. This herbicide will suppress legumes for over a year. Soil activity lasts for several months and if applied in the fall, can persist into the next year. Research in Wisconsin has shown successful establishment of legumes one year after application, but the label recommends conducting a soil bioassay before planting. Users must ensure that manure created from animals that feed on treated hay is not put onto a field that will be planted to any broadleaf crop (see label for more information). Animals should be fed aminopyralid-free forage for 3 days before they are transferred to a field with sensitive plants (e.g., clovers). Treated areas should not be harvested for 14 days after application. If treated pastures are hayed, forage cannot be sold for 18 months after treatment and must be used on-farm.

## Overdrive

**Active ingredient(s):** dicamba + diflufenzopyr

**Rate:** 4-8 oz/a.

**Adjuvants:** Use a nonionic surfactant at 1 qt/100 gal of spray solution (0.125%, vol/vol) or methylated seed oil at 1.5-2 pt/a.

**Remarks:** The product contains diflufenzopyr and dicamba. The Overdrive label lists many weeds common in pastures and noncrop areas, including biennial thistles, bindweeds, burdock, buttercups, Canada thistle, curly dock, goldenrod, horsenettle, spotted knapweed, white cockle, wild carrot, and wild parsnip.

The recommended rates of Overdrive in pastures are 4-8 oz/a. Annual broadleaf weeds and biennials in the rosette stage will be controlled at lower rates than perennials. Overdrive must be applied with a nonionic surfactant or methylated seed oil (MSO). Consider using MSO when treating hard-to-kill weeds or when plants are under moisture or temperature stress. This product has no harvesting or grazing restrictions.

## PastureGard HL

**Active ingredient(s):** triclopyr + fluroxypyr

**Rate:** 0.75-4 pt/a. Higher rates for brush, and lower rates (0.75-1.5 pt/a) for herbaceous plants. If spot treating, use a 0.5-1.0 % v/v solution.

**Adjuvants:** A nonionic surfactant is recommended at 0.5-1.0% v/v.

**Timing: POST.** Best results are observed if annual weeds are treated when they are less than 6 inches tall, biennial weeds as rosettes, and perennials at

the flower bud to flowering stages. If perennial plants are mowed in the summer, resprouting plants can be treated in the fall as long as leaves are green.

**Remarks:** Triclopyr in combination with fluroxypyr provides control of troublesome brush species and weed species other products struggle to control. Applications to brush should be made when plants are actively growing in the spring to summer. Herbaceous plants should be treated when they are small, before flowering unless the label states otherwise. While established grasses are tolerant to this product, legumes are not. If interested in reseeding after application wait three weeks for grasses and one month for legumes. Treated areas should not be harvested for 14 days after application. There are no restrictions on grazing animals in treated areas. Withdraw livestock from treated areas or stop feeding treated forage 3 days before slaughter if treated in the same growing season.

## Remedy Ultra

**Active ingredient(s):** triclopyr

**Rate:** For most brush species use 0.5-1.0% (vol/vol) mixture for foliar applications; rates can be increased (3%) if brush is large and difficult to control. The broadcast rate varies from 1-2 pts/a for annuals/biennials to 1-2 qt/a for perennial broadleaf weeds. Apply no more than 2 quarts per acre per growing season.

**Timing: POST.** Plants must be fully leafed out and actively growing when treated with foliar applications.

**Remarks:** Remedy contains triclopyr which is generally effective on woody plants and a range of herbaceous species including alder, ash, burdock, wild carrot, cherry, goldenrod, multiflora rose, sumac, and willow. It can be applied with conventional boom sprayers as a broadcast treatment, as a foliar spray to individual brush plants, or as a cut surface or basal bark treatment. While Remedy is formulated to have low volatility, applications should be avoided when temperatures are over 90°F and humidity is low. Follow label precautions to prevent spray or vapor drift to sensitive vegetation.

While no grazing restrictions exist for livestock including lactating animals on treated areas, we recommend a 14-day removal period to maximize effectiveness prior to grazing. Do not harvest hay for 14 days after treatment. If livestock will be slaughtered in the year of treatment, remove the animals from these pastures and feed forage that has not been treated with Remedy for at least 3 days.

## Roundup PowerMAX

**Active ingredient(s):** glyphosate

**Rate:** Varies with species and method of applica-

tion. See label for details.

**Adjuvants:** Ammonium sulfate at 8.5-17 lb/100 gal of spray mixture is recommended if using hard water. Additional surfactant is rarely needed.

**Timing: POST.** Treat perennial broadleaves in the late-bud to early-flower stage or treat regrowth following mowing or grazing in the fall. Treat brush species when leaves are fully expanded and plants are actively growing. Biennial and annual weeds can be treated any time, but best results are seen when they are less than 6 inches tall.

**Remarks:** Glyphosate is available in various brand names. Not all products are labeled for use in pastures; check the label before using. Products may also vary in glyphosate concentration, type and amount of surfactants, and approved use rates. Spot application of glyphosate in pastures is appropriate for treating localized weed problems such as Canada thistle or multiflora rose, which often occur in patches. No more than 10% of any acre should be spot-treated at one time. Additional applications can be made in the same pasture at 30-day intervals. Glyphosate is nonselective and will kill all treated vegetation; reseed the area with a desirable mixture of forage species. Foliar sprays of glyphosate control these brush species: alder, elms, honeysuckle, multiflora rose, oaks, poison ivy, sumac, and willow. Symptoms of injury may not appear for several weeks.

Glyphosate can also be used in pastures in wiper applicators. An 8- to 12-inch height difference between the weeds and pasture species is required. This approach is useful to suppress tall herbaceous broadleaf weeds such as chicory, goldenrod, giant ragweed, bull thistle, and plumeless thistle in pastures with birdsfoot trefoil or clover. For best results, remove domestic livestock before treating and do not graze or harvest for 14 days after treatment.

## Spike

**Active ingredient(s):** tebuthiuron

**Rate:** 0.75 oz of Spike pellets in 100 sq ft (equivalent to 20 lb/a).

**Timing:** Any time except when the soil is frozen or saturated with moisture.

**Remarks:** Spike is a persistent, nonselective herbicide registered for brush control in pastures and non-cropland areas. The Spike 20P formulation is the only formulation clearly registered for use in pastures. Spike 20P is a pelleted formulation with 20% Active ingredient. Spread pellets evenly over the area under the target plant. This approach gives excellent control of multiflora rose when 0.25 oz of Spike pellets are distributed around three to six bushes. All vegetation in the treated area will be suppressed for one to two years. Treated brush will die over a period of several weeks to months. Use great care to avoid

injury to nearby sensitive vegetation and to prevent movement into surface or groundwater. Do not apply Spike to areas where soils are sandy to loamy sand and/or the water table is less than or equal to 5 ft deep. Susceptible brush species include black locust, boxelder, maple, mulberry, multiflora rose, oak, willow, and many more. There is no grazing restriction following application, but hay cannot be harvested from treated pastures for 12 months.

## Stinger

**Active ingredient(s):** clopyralid

**Rate:** Apply 0.5-1.33 pt/a

**Adjuvants:** Surfactants and other additives are not normally added to the spray mixture.

**Timing: POST.** Best results are observed if annual weeds are treated when they are small, biennial weeds as rosettes, and perennials at the flower bud to flowering stages. If perennial plants are mowed in the summer, resprouting plants can be treated in the fall as long as leaves are green.

**Remarks:** Stinger is particularly active on plants in the sunflower family such as thistles and knap-weeds. A single application of Stinger may not eradicate Canada thistle, but it limits the competitiveness for several years. Stinger can be tank mixed with 2,4-D or dicamba for a more economical treatment. Stinger will injure or even kill treated forage legumes such as trefoil and clovers. While there is no grazing restriction for pastures, we recommend following a 14-day restriction for pastures. Do not move livestock from treated areas onto sensitive broadleaf crop areas until they have grazed for 7 days on an untreated pasture. Otherwise urine and manure may contain sufficient Stinger to injure sensitive broadleaf crops. Users cannot spread manure created from animals fed treated hay onto any field that will be planted to a broadleaf crop. Stinger cannot be used in sites vulnerable to groundwater contamination. Follow label guidelines for sprayer cleanup and drift prevention.

## Weedmaster

**Active ingredient(s):** dicamba + 2,4-D

**Rate:** 1-2 pt/a for annual, biennial, and perennial weeds and 2 qt/a for difficult-to-control perennials and brush species.

**Adjuvants:** The label recommends the addition of nonionic surfactant (0.25-0.5% vol/vol) or a crop oil concentrate (0.25% vol/vol).

**Timing: POST.** Best results are observed if annual weeds are treated when they are less than 6 inches tall, biennial weeds as rosettes, and perennials at the flower bud to flowering stages. If perennial plants are mowed in the summer, resprouting

plants can be treated in the fall as long as leaves are green.

**Remarks:** Weedmaster is a prepackaged formulation of dicamba + 2,4-D for use in pastures. Apply 1 pt/a of Weedmaster to control buttercup, lambsquarters, pigweed, and smartweed. Use 2 pt/a to control burdock, chicory, curly dock, dandelions, goldenrod, mustards, bull thistle, musk thistle, and plumeless thistle. Apply 2 qt/a to control elderberry, honeysuckle, nettle, nightshade, poison ivy, and tansy ragwort and to suppress field bindweed, Canada thistle, perennial sowthistle, and leafy spurge. Use appropriate precautions to avoid drift to nearby sensitive vegetation. This product will injure or even kill forage legumes such as clover and trefoil. Wait 3 weeks/qt/a before reseeding pasture species or injury may occur. No grazing restrictions exist for nonlactating animals, but lactating dairy cattle cannot graze treated fields for 7 days after treatment or meat animals within 30 days of slaughter. Treated grass may be harvested for hay 37 days after application.

Pasture renovation

No-till pasture renovation with herbicides is attracting interest in several areas of Wisconsin. It is best suited to fields on hillsides where tilling the soil may allow excessive erosion to occur. Success depends on timely rains to stimulate the germination of the forage seeds. The following herbicides aid in no-till pasture renovation. Be sure broadleaf weeds have been controlled before interseeding legumes into pastures. After the legume is established, there are no selective herbicides available for broadleaf weed control. Where biennial thistles are present, treat for at least 2 years before renovation to reduce their abundance.

See table 4-5 for a summary of harvest and grazing intervals following herbicide use in pastures.

Gramoxone SL

**Active ingredient(s):** paraquat  
**Rate:** Apply 1-2 pt/a. Use the high rate to suppress smooth brome and orchardgrass. Increase both the Gramoxone rate and the volume of water as the density and size of vegetation to be treated increases.  
**Adjuvants:** Add nonionic surfactant at 1-2 pt/100 gal of spray solution.  
**Timing: PRE.** Apply preplant or at the time of seeding in spring or early summer.  
**Remarks:** Gramoxone suppresses the competition of existing sod and emerged broadleaf weeds and grasses to facilitate seeding grasses and/or forage legumes such as alfalfa, clovers, and birdsfoot trefoil into existing pastures without tillage. Apply in at least 20 gal/a of water and treat only closely grazed or mowed pastures that are no more than 2-3 inches tall at the time of spraying. The burn-down action of Gramoxone facilitates the no-till seeding (pasture seeding) of more desirable forage legumes and grasses. No-till seeding with Gramoxone is more successful in bluegrass pastures than in pastures containing large amounts of quackgrass. Quackgrass recovers more rapidly after treatment than bluegrass and may compete vigorously with legume seedlings. Gramoxone will not

kill perennial weeds such as dandelions. In fields infested with broadleaf weeds, use 2,4-D or dicamba in the fall before spring renovation. Allow at least 42 days between treatment and first grazing.

Roundup PowerMAX

**Active ingredient(s):** glyphosate  
**Rate:** Varies with species and method of application, but typically ranges from 0.5-1.5 lb ae/a. See the label for details.  
**Adjuvants:** Ammonium sulfate at 8.5-17 lb/100 gal of spray mixture is recommended if using hard water. Additional surfactant is rarely needed.  
**Timing: PRE.** Apply to actively growing vegetation before planting desirable species.  
**Remarks:** Several brands of glyphosate are registered for pasture renovation and can be used to control Canada thistle, quackgrass, and other perennial weeds before reseeding forages, grasses, and legumes. Treated areas can be tilled before seeding or planted with no-till seeders. Erosion on hillsides may occur as glyphosate kills all treated vegetation. No grazing or harvesting restrictions exist unless more than 2.25 lb ae/a is applied. If this rate is exceeded, wait 8 weeks following treatment before grazing or harvesting hay.

Table 4-5. Harvest and/or grazing restrictions for herbicides registered for use in forages/pastures<sup>a</sup>

Herbicide	Use(s)	Type of animal	Interval between application and grazing or harvest	Comments
2,4-D	pastures	lactating other	7 days 3–7 days	2,4-D labels vary. See specific product label. Do not harvest grass for hay within 30 days of use.
Butyrac 200	alfalfa, trefoil	all	60 days: new seedings 30 days: established stands	—
Chaparral	pastures	all	0 days	Before transferring animals from treated areas to areas planted with sensitive broadleaf crops, feed animals for 3 days on untreated forage. Forage and manure created from animals feeding on treated forage must remain on farm for 18 months. Manure can only be spread on fields that will grow grass crops. Must notify owner/operator of restrictions and retain records for 2 years
Chateau	alfalfa	all	25 days	—
Crossbow	pastures	lactating  other	next season: grazed 14 days: harvested 0 days	Remove livestock from treated areas at least 3 days before slaughter during year of treatment.

<sup>a</sup> Labels may have changed after this table was prepared. Consult current labels to verify the information.

Continued on next page

**Table 4-5.** Harvest and/or grazing restrictions for herbicides registered for use in forages and pastures<sup>a</sup> (continued)

Herbicide	Use(s)	Type of animal	Interval between application and grazing or harvest	Comments
Curtail	pastures	lactating other	14 days 0 days	Do not harvest hay for 7 days after application. Remove meat animals 7 days before slaughter unless 2 weeks have elapsed since application. Before transferring animals from treated areas to areas planted with sensitive broadleaf crops, feed animals for 3 days on untreated forage. Forage and manure created from animals feeding on treated forage must remain on farm for 18 months. Manure can only be spread on fields that will grow grass crops. Must notify owner/operator of restrictions and retain records for 2 years
dicamba	pastures	lactating  other	7 days: <1 pt/a 21 days: 1–2 pt/a 40 days: 2–4 pt/a 0 days	Remove meat animals from treated areas 30 days before slaughter; 30–70 days must elapse if hay is to be harvested and fed to dairy animals. See label for restrictions.
DuraCor	pastures	all	0 days	Before transferring animals from treated areas to areas planted with sensitive broadleaf crops, feed animals for 3 days on untreated forage. Forage and manure created from animals feeding on treated forage must remain on farm for 18 months. Manure can only be spread on fields that will grow grass crops. Must notify owner/operator of restrictions and retain records for 2 years
Eptam	alfalfa, clovers, trefoil	all	14 days	—
Escort	pastures	all	0 days	No grazing restrictions.
Extreme	alfalfa	all	30 days	—
GrazonNext HL (ForeFront HL)	pastures	all	7 days: harvested 0 days: grazed	Before transferring animals from treated areas to areas planted with sensitive broadleaf crops, feed animals for 3 days on untreated forage. Forage and manure created from animals feeding on treated forage must remain on farm for 18 months. Manure can only be spread on fields that will grow grass crops. Must notify owner/operator of restrictions and retain records for 2 years
Gramoxone SL	pasture renovation	all	0–60 days	Only apply to pastures ≤3 inches tall. Consult the label for specific grazing restrictions.
Metribuzin	alfalfa	all	28 days	—
Milestone	pastures	all	0 days	Before transferring animals from treated areas to areas planted with sensitive broadleaf crops, feed animals for 3 days on untreated forage. Forage and manure created from animals feeding on treated forage must remain on farm for 18 months. Manure can only be spread on fields that will grow grass crops. Must notify owner/operator of restrictions and retain records for 2 years
Overdrive	pastures	all	0 days	No grazing restrictions.
PastureGard HL	pastures	all	0 days: grazed 14 days: harvested	Before transferring animals from treated areas to areas planted with sensitive broadleaf crops, feed animals for 3 days on untreated forage. Forage and manure created from animals feeding on treated forage must remain on farm for 18 months. Manure can only be spread on fields that will grow grass crops. Must notify owner/operator of restrictions and retain records for 2 years

<sup>a</sup> Labels may have changed after this table was prepared. Consult current labels to verify the information.*Continued on next page*

**Table 4-5.** Harvest and/or grazing restrictions for herbicides registered for use in forages and pastures<sup>a</sup> (continued)

Herbicide	Use(s)	Type of animal	Interval between application and grazing or harvest	Comments
Poast Plus	alfalfa, clovers, trefoil	all	7 days: undried forage 14 days: dry hay 20 days: dried clover	Grazing restrictions same as undried forage.
Prowl H2O	alfalfa	all	28 days ≤ 2.1 qt/a 50 days > 2.1 qt/a	—
Pursuit	alfalfa, clover	all	30 days	—
Raptor	alfalfa	all	0 days	—
Remedy Ultra	pasture	all	0 days grazing 14 days hay	During the season of application remove livestock from treated areas at least 3 days before slaughter and feed forage that has not been treated with Remedy.
Roundup PowerMAX	spot treatment or selective equipment in forage grasses and legumes	all	0 days: <2 qt/a 7 days: >2 qt/a	If more than 2 qt/a is applied with spot treatments, do not treat more than 10% of any acre.
	pasture renovation	all	0 days: <2 qt/a 8 weeks: >2 qt/a	—
	alfalfa, preharvest	all	36 hours	Only for fields being rotated to another crop.
Select Max	alfalfa, trefoil	all	15 days	—
Spike	pastures	all	0 days grazing 12 months hay	
Stinger	pastures	all	0 days	Before transferring animals from treated areas to areas planted with sensitive broadleaf crops, feed animals for 3 days on untreated forage. Forage and manure created from animals feeding on treated forage must remain on farm for 18 months. Manure can only be spread on fields that will grow grass crops. Must notify owner/operator of restrictions and retain records for 2 years
Treflan	alfalfa	all	21 days	—
Velpar	alfalfa	all	30 days	—
Weedmaster	pastures	lactating other	7 days grazed 0 days grazed	Remove meat animals from treated areas 30 days before slaughter.
		all	37 days hay	
Warrant	alfalfa	all	20 days	—

<sup>a</sup> Labels may have changed after this table was prepared. Consult current labels to verify the information.

# Forage and pasture insect management

Insecticides suggested in this section are intended as a guide to assist you in selecting chemical insect control options during the season. This book provides an overview of product registrations for specific field crop insect pests; it is not intended as an exhaustive insecticide label source. Product inclusion or omission does not imply endorsement by University of Wisconsin-Extension. Remember, certain insecticides are produced by different manufacturers and directions for use, rate, and method of application may vary by formulation. Therefore, always read the insecticide label completely before using the material.

As of this publication date, EPA has revoked all tolerances for the use of chlorpyrifos in feed and food crops effective February 28, 2022. All insecticides containing this active ingredient have been removed from this list.

Insecticides are often interchangeably referred to by their common and trade names. Trade names such as Mustang Maxx are capitalized, while common chemical names—zeta-cypermethrin in this example—are not.

A number of the products listed in this section are restricted-use insecticides. We discuss restricted-use pesticides in the beginning of this publication. Refer to appendix table 7-2 for a list of insecticides that currently require certification to be applied. It is possible that additional insecticides will be classified before the next growing season. Contact your county Extension agent for additional information on insecticide restriction. Refer to table 4-6 for a scouting calendar for forage insect pests by forage growth stage.

## Reducing insecticide hazards to bees

Insecticides help control insect pests, but they also can kill beneficial insects such as honeybees. Notifying beekeepers before using insecticides and apply only between 4 p.m. and nightfall, when bees are least likely to be actively foraging will reduce non target effects. Avoid spraying alfalfa or clover when in blossom. Some insecticides state that applications should not be made during bloom. Failure to heed this warning is a use inconsistent with the label and therefore, a violation of the law.

If insects are damaging blooming alfalfa, harvest the alfalfa and, if necessary, spray the new growth to control the insects. However, before spraying regrowth, check for the presence of blossoming plants. During some years, heavy populations of blossoming white clover appear in alfalfa stubble shortly after harvest of

the first crop. Bees foraging on these blossoms will be killed if regrowth is sprayed. Always try to select an effective insecticide that is the least toxic to bees.

Avoid spraying ditch banks, fence-rows, and roadsides when plants are in bloom.

**Advance notification:** Wisconsin beekeepers may request a 24 hour advance notice of applications of certain pesticides made within a 1.5-mile radius of their beeyards. The insecticides involved are those which are labeled “Highly Toxic to Bees”. Beekeepers desiring advance notification must provide their request in writing to the landowner or person controlling the use of the land on which pesticides may be applied either by ground or aerially. All requests expire at the end of each calendar year.

Table 4-6. Periods to scout for insect pests of forages

Insect pest	Spring growth	Second growth	Third growth	New seeding
Alfalfa blotch leafminer	yes	yes	yes	yes
Alfalfa caterpillar	no	yes	yes	no
Alfalfa weevil	yes	new growth only	no	seldom
Aphids	yes	yes	yes	yes
Blister beetles <sup>a</sup>	no	yes <sup>b</sup>	yes <sup>b</sup>	yes <sup>b</sup>
Cutworms	yes	yes	yes	yes
Grasshoppers	seldom	seldom	seldom	seldom
Plant bugs	no	yes	yes	yes
Potato leafhopper	no	yes	yes	yes
Spittlebug nymphs	yes	no	no	yes

<sup>a</sup>Blister beetles in hay can be toxic to horses.  
<sup>b</sup>When abundant, blister beetles make fresh-cut forage distasteful.

## Alfalfa insects

### Alfalfa blotch leafminer

The alfalfa blotch leafminer, native to Europe, was first reported in the Midwestern US in 1996.

Adults are small, black, humpbacked flies that emerge from overwintering pupae located on the surface of the soil. The first indication of their presence is the appearance of numerous pinholes (from a few to 100+) in the leaflets. These holes are mostly signs of adult feeding but can also serve as egg-laying sites. Females lay one to three eggs per alfalfa leaflet. Small yellow maggots hatch within the leaf and feed between the upper and lower leaf surfaces. The resulting tunnel usually starts at the base of the leaflet and widens with movement toward the tip of the leaf, resulting in the “blotch” appearance. When fully grown, they crawl out of the leaves, drop to the ground, and pupate. A second generation of flies emerge in about 1 week (mid-July) and is followed by a third generation in late August.

Punctures and blotches result in leaf deterioration and possible defoliation. Leaf damage lessens quality, while leaf-drop reduces yield. Significant yield loss should only occur if damaged leaves drop from the plant or are shaken from the hay during harvesting.

In the upper Midwest, harvest of the first crop normally controls the first generation. Development of the second and third generations, however, may not correspond as closely with cutting schedules, and this could lead to more extensive injury in those cuttings. As is true for the alfalfa weevil, cooler weather favors alfalfa development over that of the insect.

Insecticidal control can be effective if applied during the “pinhole” stage, but treatment will not pay unless leaf drop is extensive. Treatment may be justified when 30 to 40% of the leaflets exhibit pinhole feeding injury. Because the eggs hatch over an ex-

tended period, the adults are mobile, and maggots are protected within the leaflet; insecticide trials have had marginal control results.

Biological control of this pest is well established in the northeastern US. Biological control is also a major control factor in the Midwest since parasitized larvae were detected in Wisconsin in 1998.

### Alfalfa caterpillar

Larvae are dark green with a narrow white stripe along each side of the body through which runs a thin red line. When fully grown they are 1.5 inches long. This insect is seldom of concern to alfalfa produced in the Midwest, and treatment is not suggested unless populations reach 10 or more per sweep.

The adult stage attracts the most attention because swarms of these sulfur-yellow butterflies can be seen flying over alfalfa fields during mid- to late summer.

### Alfalfa weevil

Alfalfa weevil larvae are slate-colored when small but bright green when fully grown ( $\frac{3}{8}$  inch). There is a white stripe down the back, and the head is black. They chew and skeletonize leaves. If larval populations are large, the entire plant may be defoliated, giving the field a grayish cast. Although larvae are present from May well into the summer, peak feeding activity falls off by mid-June.

When full grown, the larvae spin silken cocoons on the plants, within the curl of fallen dead leaves, or within litter on the ground. They change into adults in 1 to 2 weeks. The adults are dark gray to brown snout beetles measuring about  $\frac{1}{4}$  inch in length. There is a distinct dark shield-like mark on the back. After feeding a short time, most adults leave the field and enter a resting period that lasts until fall. Adults then return to the alfalfa field and lay a few eggs before the onset of cold temperatures. This

egg laying is insignificant; most eggs are laid during the following spring.

Although most of the feeding damage is done by larvae, at times adult damage is significant. Larvae and adults can continue to feed on new growth of the second crop. Begin checking alfalfa fields for signs of weevil feeding in mid-May. This usually gives sufficient warning of developing problems. Since peak larval activity typically occurs from mid-May to early June, check fields every few days. However, population peaks vary from year to year, making it difficult to predict the extent of activity and exact time when peak populations will occur. Therefore, it is important to periodically check with your county Extension office for updates on the alfalfa weevil situation.

Control measures should be implemented when 40% of the plant tips of the first crop show obvious signs of damage. This does not mean 40% defoliation, but that 40% of the plants are beginning to show signs of feeding activity. If this occurs within 7-10 days of the suggested harvest date for your area, harvest the hay as soon as possible and watch the stubble for signs of weevil damage to new growth of the second crop. Early cutting will save the cost of an insecticide application. If you cannot harvest, spray as soon as possible. If 40% tip damage is found more than 10 days ahead of the suggested harvest date, the field should be sprayed as soon as possible. Harvesting too early could be detrimental to alfalfa stands. Growers may not be able to harvest fast enough to stay ahead of the weevil in years of high alfalfa weevil abundance. If a field is harvested early because of alfalfa weevil problems, or if substantial damage has occurred with a standard harvesting schedule, the stubble must be checked carefully for signs of damage to new growth of the second crop. Some fields may fail to green up because adults and larvae are consuming new crown buds as fast as they are formed. Check the stubble, the soil surface around alfalfa plants, and under leaf litter for larvae and adults. If you find them and if

there is no sign of regrowth in 3-4 days after harvest, spray the stubble as soon as possible. Treatment is also suggested if feeding damage is apparent on 50% of the new growth.

If you find no larvae or adults, lack of regrowth is due to other factors. Remember that dry weather will often delay growth of the new crop.

### Aphids

Two types of aphids can be found on alfalfa: the green and rose-colored pea aphids and the spotted alfalfa aphids, which are yellow and faintly dark spotted. Aphids congregate on stems and leaves and suck plant sap. This causes stunting and yellowing of alfalfa. If aphids are abundant, treat before these symptoms occur. Pea aphids can cause significant damage when numbers exceed 100 per sweep, particularly if soil moisture is below plant requirements.

### Grasshoppers

Occasionally, grasshoppers are abundant enough to concern farmers. No treatment is suggested until populations reach 20 per square yard in field margins or 8 per square yard within alfalfa fields. Treat while grasshoppers are still small.

### Plant bugs

Plant bugs that are particularly important to alfalfa production are the tarnished plant bug and the alfalfa plant bug. The adult tarnished plant bug is ¼ inch long and brown. Nymphs are green with black spots on the back. Adult alfalfa plant bugs are ⅜ inch long and are light green. Nymphs are green with red eyes.

Plant bugs extract plant sap with their tube-like mouthparts. In high populations, this can result in stunted alfalfa growth or crinkled, puckered leaves. On alfalfa less than 3 inches tall, treat if there are three plant bug adults and/or nymphs per sweep; on taller alfalfa, treat when there are five or more adults and/or nymphs per sweep.

Insecticide applied within 7-10 days of harvest is unlikely to increase alfalfa yield and quality. In addition, preharvest intervals may restrict insecticide use during this time. The best solution for such fields is to harvest early.

Note that while plant bug feeding can stunt plants and cause crinkling and puckering of leaves, these alfalfa growth aberrations also have been found in the absence of plant bugs.

### Potato leafhopper

Potato leafhoppers are small (⅛ inch), green, wedge-shaped insects. Adults and nymphs look similar except that adults have wings, and nymphs are smaller and wingless. Leafhopper nymphs can be distinguished from other small green insects by their sideways movement when disturbed. Potato leafhoppers feed on alfalfa by inserting their piercing-sucking mouthparts into leaves and tapping into the food-conducting tissue (phloem) to extract plant sugars, minerals, and other compounds. As they feed, they inject a toxin into the plant to inhibit water and nutrient transport. Feeding damage results in plant stunting, and the yellowing of the leaves in a telltale V-shaped pattern starting at the leaf tip. Serious infestations of leafhoppers will also reduce the yield and protein content of the plants.

Potato leafhoppers are mid- to late-season alfalfa pests that migrate to Wisconsin from southern areas. First-crop alfalfa harvested at the proper time escapes damage. However, monitor subsequent crops for leafhoppers. New seedlings must also be monitored carefully and sprayed at threshold. Failure to do so can reduce yield throughout the life of the stand due to stress caused by leafhoppers during establishment.

Because potato leafhopper populations vary from year to year, populations within a given year cannot be predicted, and fields must be monitored weekly to accurately determine damage potential. Both nymphs and adults feed on alfalfa and should be counted together when scout-

ing fields. Use a 15-inch diameter insect sweep net to take samples. A total of 100 sweeps should be taken throughout the field. Walk a W-shape through the field, taking 20 consecutive sweeps in each of five randomly selected areas. To obtain an accurate population estimate, sample when plants are dry and avoid field edges. Cold, wet, or windy conditions may temporarily knock adults and nymphs from plants, resulting in an inaccurate sweep count. As you sample, keep a running total of the number of leafhoppers caught at each location and divide the total by 100. Refer to table 4-7 for treatment thresholds.

Economic thresholds are based on the average number of leafhoppers per sweep and on plant height. Taller plants have higher treatment thresholds because they can withstand more damage and will be harvested sooner than shorter plants.

### Spittlebugs

**Table 4-7.** Treatment thresholds for potato leafhoppers on alfalfa<sup>a</sup>

Alfalfa stem height (inches)	Leafhoppers net sweep average
3	0.2
6	0.5
8-11	1.0
12-14	2.0

<sup>a</sup> Treat when leafhopper densities reach these thresholds.

Spittlebug nymphs appear in early May in extreme southern Wisconsin. These soft, orange or green bugs can be found in white spittle masses in leaf axils and later in the clumps of new growth at tips of stems. They suck plant sap and cause stunting but do not yellow the alfalfa. Treat if there is an average of at least one spittlebug per stem.

## Insect pests of birdsfoot trefoil, clover, and pasture

Grasshoppers and spittlebugs occasionally cause problems in clover fields.

Grasshoppers are occasionally a problem in pastures. Treat when nymphs are abundant and before migration into row crops is extensive. Apply sprays while grasshoppers are small. Notify nearby beekeepers at least 48 hours before you use an insecticide if blossoming weeds or other plants are present. Do not allow sprays to drift into beeyards or onto blooming crops or weeds.

Use the insecticides listed in table 4-8 to control insect pests of birdsfoot trefoil, clover, and pastures.

**Table 4-8.** Insecticide suggestions for birdsfoot trefoil, clover, pasture, and rangeland

Insect	Insecticide <sup>a</sup>	Amount of product/a	Remarks, precautions <sup>b</sup>
<b>Birdsfoot Trefoil Insects</b>			
Plant bugs (check labels for specific species)	Mustang Maxx	2.24–4.0 fl oz	<b>Preharvest interval (days):</b> 3 for cutting or grazing; 7 for harvesting seed <b>Maximum rate:</b> 12.0 fl oz/a or 0.15 lb ai/a/season
Grasshoppers	Mustang Maxx	2.8–4.0 fl oz	<b>Preharvest interval (days):</b> 3 for cutting or grazing; 7 for harvesting seed <b>Maximum rate:</b> 12.0 fl oz/a or 0.075 lb ai/a/season
Potato leafhoppers	Mustang Maxx	2.24–4.0 fl oz	<b>Preharvest interval (days):</b> 3 for cutting or grazing; 7 for harvesting seed <b>Maximum rate:</b> 12.0 fl oz/a or 0.075 lb ai/a/season
	Sevin XLR Plus	1 qt	<b>Preharvest interval (days):</b> See label (varies by crop) <b>Maximum rate:</b> 1.5 qt/a per cutting <b>Bee precaution:</b> Do not apply to target crops or weeds in bloom
<b>Clover Insects</b>			
Grasshoppers	Mustang Maxx	2.8–4.0 fl oz	<b>Preharvest interval (days):</b> 3 for cutting or grazing; 7 for harvesting seed <b>Maximum rate:</b> 12.0 fl oz/a or 0.075 lb ai/a/season
Potato leafhoppers	Sevin XLR Plus	1 qt	<b>Preharvest interval (days):</b> See label (varies by crop) <b>Maximum rate:</b> 1.5 qt/a per cutting <b>Bee precaution:</b> Do not apply to target crops or weeds in bloom

<sup>a</sup> All insecticides in this table are to be applied to the plant foliage.

<sup>b</sup> Notify nearby beekeepers before you use insecticides and apply only between 4 p.m. and nightfall, when bees are least likely to be exposed. Do not treat clover during bloom. Treatment of clover fields that contain blossoming weeds or other plants can result in severe bee losses.

*Continued on next page*

**Table 4-8.** Insecticide suggestions for birdsfoot trefoil, clover, and pasture (continued)

Insect	Insecticide <sup>a</sup>	Amount of product/a	Remarks, precautions <sup>b</sup>
<b>Armyworm in Pasture</b>			
Threshold: 3 or more larvae/sq ft, and larvae are less than 3/4-1 inch long.			
Armyworm	Besiege	6.0–10.0 fl oz	<b>Preharvest interval:</b> 0 days for grazing or cut for forage, do not cut grass to be dried for and harvested for hay until 7 days after the last application <b>Maximum rate:</b> 27.0 fl oz/a of Besiege or 0.09 lb ai/a of lambda-cyhalothrin-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season
	Mustang Maxx	2.8–4.0 fl oz	<b>Preharvest interval (days):</b> 0 for forage and hay <b>Maximum rate:</b> 16.0 fl oz/a or 0.10 lb ai/a/season
	Sevin XLR Plus	1.0–1.5 qt	<b>Preharvest interval (days):</b> See label (varies by crop) <b>Maximum rate:</b> 1.5 qt/a per cutting <b>Bee precaution:</b> Do not apply to target crops or weeds in bloom.
	Tracer	1.0–2.0 fl oz	<b>Preharvest interval (days):</b> 3 for hay or fodder, do not allow cattle to graze from treated area until spray has dried. <b>Maximum rate:</b> 6.0 fl oz or 0.188 lb ai spinosad/a/season
	Silencer	2.56–3.84 fl oz	<b>Preharvest interval (days):</b> 0 days for grazing or cut for forage. Do not cut grass to be dried and harvested for hay until 7 days after last application. Do not apply more than 0.09 lb. a.i. (0.72 pts. of product) per acre per season
	Warrior II	1.28–1.92 fl oz	<b>Preharvest interval (days):</b> 0 or grazing or cut for forage, do not cut grass to be dried and harvested for hay until 7 days after the last application, see label (varies by crop) <b>Maximum rate:</b> 0.09 lb ai/a (5.76 fl oz or 0.36 pt of Warrior II/a) per season
<b>Grasshoppers in Rangeland</b>			
Threshold: 8-40 grasshoppers/sq yd			
Grasshoppers	Besiege	6.0–10.0 fl oz	<b>Preharvest interval:</b> 0 days for grazing or cut for forage, do not cut grass to be dried for and harvested for hay until 7 days after the last application <b>Maximum rate:</b> 27.0 fl oz/a of Besiege or 0.09 lb ai/a of lambda-cyhalothrin-containing products or 0.2 lb ai/a of chlorantraniliprole-containing products per season
	Mustang Maxx	2.8–4.0 fl oz	<b>Preharvest interval (days):</b> 0 for forage and hay <b>Maximum rate:</b> 16.0 fl oz/a or 0.10 lb ai/a/season
	Sevin XLR Plus	0.5 qt	<b>Comment:</b> May be harvested or grazed the same day as treatment, do not apply more than 1 qt/a per year
	Silencer	2.56–3.84 fl oz	<b>Preharvest interval (days):</b> 0 days for grazing or cut for forage. Do not cut grass to be dried and harvested for hay until 7 days after last application. Do not apply more than 0.09 lb. a.i. (0.72 pts. of product) per acre per season
	Warrior II	1.28–1.92 fl oz	<b>Preharvest interval (days):</b> 0 or grazing or cut for forage, do not cut grass to be dried and harvested for hay until 7 days after the last application, see label (varies by crop) <b>Maximum rate:</b> 0.09 lb ai/a (5.76 fl oz or 0.36 pt of Warrior II/a) per season

<sup>a</sup> All insecticides in this table are to be applied to the plant foliage.

<sup>b</sup> Notify nearby beekeepers before you use insecticides and apply only between 4 p.m. and nightfall, when bees are least likely to be exposed. Do not treat clover during bloom. Treatment of clover fields that contain blossoming weeds or other plants can result in severe bee losses.

## Insecticide suggestions for alfalfa

### Alfalfa blotch leafminer

**Threshold:** Treatment may be warranted when 30 to 40% of leaflets exhibit pinhole feeding injury.

#### Baythroid XL

**Rate:** 2.0–2.8 fl oz

**Active ingredient:** cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 7

**Maximum rate:** 22.4 fl oz/a (0.175 lb ai/a) per season; 5.6 fl oz/a (0.044 lb ai/a) allowed per cutting

#### Besiege

**Rate:** 9.0–10.0 fl oz

**Active ingredient:** lambda-cyhalothrin, chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 1 day for forage and 7 days for hay

**Maximum rate:** 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin-containing products or 0.2 lb ai of chlorantraniliprole-containing products/a/season

*Bee precaution: Make applications when bees are not actively foraging by applying during the early morning or during evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. Remove bee shelters during and for 2–3 days following application. Do not apply directly to bee shelters.*

#### Declare 1.25CS

**Rate:** 1.54 fl oz

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 1 day for forage and 7 days for hay

**Maximum rate:** 0.06 lb ai (0.38 pt)/a/season

*Avoid application when bees are actively foraging by applying during the early morning or during evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. It may be advisable to remove bee shelters during and for 2 to 3 days following application. Avoid direct application to bee shelters.*

#### Imidan 70W

**Rate:** 1.0–1.33 lb

**Active ingredient:** phosmet

**IRAC code:** 1B

**Preharvest interval (days):** 7

**Maximum rate:** Do not apply more than once per cutting

*Do not apply to alfalfa in the bloom period. Do not use with latex or pineolene-based adjuvants or any agricultural sticker or extender.*

#### Sevin XLR Plus

**Rate:** 1.0–1.5 qt

**Active ingredient:** carbaryl

**IRAC code:** 1A

**Preharvest interval (days):** 7

**Maximum rate:** 1.5 qt/a per cutting

*Bee precaution: Do not apply to target crops or weeds in bloom.*

#### Silencer

**Rate:** 3.84 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 7 hay, 1 forage

**Maximum rate:** Do not apply more than 0.03 lb ai (0.24 pt) per acre per cutting. Do not apply more than 0.12 lb ai (0.96 pt.) per acre per season

#### Warrior II

**Rate:** 1.92 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 1 for forage and 7 for hay

**Maximum rate:** 0.12 lb ai/a (7.68 fl oz/a or 0.48 pt/a of Warrior II) per season

*Bee precaution: Avoid application when bees are actively foraging by applying during the early morning or during the evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. It may be advisable to remove bee shelters during and for 2–3 days following application. Avoid direct application to bee shelters.*

### Alfalfa caterpillar

**Threshold:** 10 or more larvae per sweep

#### Baythroid XL

**Rate:** 1.6–2.8 fl oz

**Active ingredient:** cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 7

**Maximum rate:** 22.4 fl oz/a (0.175 lb ai/a) per season; 5.6 fl oz/a (0.044 lb ai/a) allowed per cutting

#### Belt 4SC

**Rate:** 2.0–4.0 fl oz/a

**Active ingredient:** flubendiamide

**IRAC code:** 28

**Preharvest interval (days):** 0 forage and hay

**Maximum rate:** Do not apply more than 4.0 fl oz/a/cutting. Do not apply more than 12.0 fl oz per acre (0.375 lb ai/A) per year

#### Besiege

**Rate:** 5.0–8.0 fl oz

**Active ingredient:** lambda-cyhalothrin, chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 1 day for forage and 7 days for hay

**Maximum rate:** 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin-containing products or 0.2 lb ai of chlorantraniliprole-containing products/a/season

*Bee precaution: Make applications when bees are not actively foraging by applying during the early morning or during evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. Remove bee shelters during and for 2–3 days following application. Do not apply directly to bee shelters.*

#### Declare 1.25CS

**Rate:** 0.77–1.28 fl oz

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 1 day for forage and 7 days for hay

**Maximum rate:** 0.06 lb ai (0.38 pt)/a/season

*Avoid application when bees are actively foraging by applying during the early morning or during evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. It may be advisable to remove bee shelters during and for 2 to 3 days following application. Avoid direct application to bee shelters.*

#### Fastac EC

**Rate:** 2.2–3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 3 days for cutting or grazing, 7 days of harvesting seed

**Maximum rate:** 3.8 fl oz (0.025 lb ai)/a per cutting; and a maximum of 11.4 fl oz (0.075 lb ai)/a per season

## Fastac CS

**Rate:** 2.2-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 3 days for cutting or grazing, 7 days of harvesting seed

**Maximum rate:** 3.8 fl oz (0.025 lb ai)/a per cutting; and a maximum of 11.4 fl oz (0.075 lb ai)/a per season

## Mustang Maxx

**Rate:** 2.24-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 3 for cutting or grazing

**Maximum rate:** maximum of 8 fluid oz of product per acre may be applied per cutting with a maximum 24 fluid oz of product per acre per season

## Sevin XLR Plus

**Rate:** 1 qt

**Active ingredient:** carbaryl

**IRAC code:** 1A

**Preharvest interval (days):** 7

**Maximum rate:** 1.5 qt/a per cutting

*Bee precaution: Do not apply to target crops or weeds in bloom.*

## Silencer

**Rate:** 1.92-3.2 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 7 hay, 1 forage

**Maximum rate:** Do not apply more than 0.03 lb ai (0.24 pt) per acre per cutting, Do not apply more than 0.12 lb ai (0.96 pt.) per acre per season

## Warrior II

**Rate:** 0.96-1.6 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 1 for forage and 7 for hay

**Maximum rate:** 0.12 lb ai/a (7.68 fl oz/a or 0.48 pt/a) per season

*Bee precaution: Avoid application when bees are actively foraging by applying during the early morning or during the evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. It may be advisable to remove bee shelters during and for 2-3 days following application. Avoid direct application to bee shelters.*

## Alfalfa weevil

**Threshold:** 40% of plants with tip feeding on first crop; 50% feeding damage on second crop regrowth

## Baythroid XL

**Rate:** 1.6-2.8 fl oz

**Active ingredient:** cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 7

**Maximum rate:** 22.4 fl oz/a (0.175 lb ai/a) per season; 5.6 fl oz/a (0.044 lb ai/a) allowed per cutting

## Besiege

**Rate:** 6.0-10.0 fl oz

**Active ingredient:** lambda-cyhalothrin, chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 1 day for forage and 7 days for hay

**Maximum rate:** 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin-containing products or 0.2 lb ai of chlorantraniliprole-containing products/a/season

*Bee precaution: Make applications when bees are not actively foraging by applying during the early morning or during evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. Remove bee shelters during and for 2-3 days following application. Do not apply directly to bee shelters.*

## Declare 1.25CS

**Rate:** 1.02-1.54 fl oz

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 1 day for forage and 7 days for hay

**Maximum rate:** 0.06 lb ai (0.38 pt)/a/season

*Avoid application when bees are actively foraging by applying during the early morning or during evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. It may be advisable to remove bee shelters during and for 2 to 3 days following application. Avoid direct application to bee shelters.*

## Fastac EC

**Rate:** 2.2-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 3 days for cutting or grazing, 7 days of harvesting seed

**Maximum rate:** 3.8 fl oz (0.025 lb ai)/a per cutting; and a maximum of 11.4 fl oz (0.075 lb ai)/a per season

## Fastac CS

**Rate:** 2.2-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 3 days for cutting or grazing, 7 days of harvesting seed

**Maximum rate:** 3.8 fl oz (0.025 lb ai)/a per cutting; and a maximum of 11.4 fl oz (0.075 lb ai)/a per season

## Imidan 70W

**Rate:** 1.0-1.33 lb

**Active ingredient:** phosmet

**IRAC code:** 1B

**Preharvest interval (days):** 7

**Maximum rate:** Do not apply more than once per cutting. Do not apply to alfalfa in the bloom period. Do not use with latex or pineolene-based adjuvants or any agricultural sticker or extender.

## Mustang Maxx

**Rate:** 2.24-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 3 for cutting or grazing

**Maximum rate:** maximum of 8 fluid oz of product per acre may be applied per cutting with a maximum 24 fluid oz of product per acre per season

## Sevin XLR Plus

**Rate:** 1.5 qt

**Active ingredient:** carbaryl

**IRAC code:** 1A

**Preharvest interval (days):** 7

**Maximum rate:** 1.5 qt/a per cutting

*Bee precaution: Do not apply to target crops or weeds in bloom.*

## Silencer

**Rate:** 2.56-3.84 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 7 hay, 1 forage

**Maximum rate:** Do not apply more than 0.03 lb ai (0.24 pt) per acre per cutting. Do not apply more than 0.12 lb ai (0.96 pt.) per acre per season.

## Warrior II

**Rate:** 1.28-1.92 fl oz

Active ingredient: lambda-cyhalothrin

IRAC code: 3A

**Preharvest interval (days):** 1 for forage and 7 for hay

**Maximum rate:** 0.12 lb ai/a (7.68 fl oz/a or 0.48 pt/a of Warrior II) per season

*Bee precaution: Avoid application when bees are actively foraging by applying during the early morning or during the evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. It may be advisable to remove bee shelters during and for 2-3 days following application. Avoid direct application to bee shelters.*

## Aphid

**Threshold:** 100 aphids per sweep

## Besiege

**Rate:** 6.0-10.0 fl oz

**Active ingredient:** lambda-cyhalothrin, chlorantraniliprole

IRAC code: 3A, 28

**Preharvest interval (days):** 1 day for forage and 7 days for hay

**Maximum rate:** 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin-containing products or 0.2 lb ai of chlorantraniliprole-containing products/a/season.

*Bee precaution: Make applications when bees are not actively foraging by applying during the early morning or during evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. Remove bee shelters during and for 2-3 days following application. Do not apply directly to bee shelters.*

## Declare 1.25CS

**Rate:** 1.02-1.54 fl oz

**Active ingredient:** gamma-cyhalothrin

IRAC code: 3A

**Preharvest interval (days):** 1 day for forage and 7 days for hay

**Maximum rate:** 0.06 lb ai (0.38 pt)/a/season

*Avoid application when bees are actively foraging by applying during the early morning or during evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. It may be advisable to remove bee shelters during and for 2 to 3 days following application. Avoid direct application to bee shelters.*

## Fastac EC

**Rate:** 2.2-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

IRAC code: 3A

**Preharvest interval (days):** 3 days for cutting or grazing, 7 days of harvesting seed.

**Maximum rate:** 3.8 fl oz (0.025 lb ai)/a per cutting; and a maximum of 11.4 fl oz (0.075 lb ai)/a per season

*Aphid control may be variable depending on species and host-plant relationships.*

## Fastac CS

**Rate:** 2.2-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

IRAC code: 3A

**Preharvest interval (days):** 3 days for cutting or grazing, 7 days of harvesting seed.

**Maximum rate:** 3.8 fl oz (0.025 lb ai)/a per cutting; and a maximum of 11.4 fl oz (0.075 lb ai)/a per season.

## Imidan 70W

**Rate:** 1.0-1.33 lb

**Active ingredient:** phosmet

IRAC code: 1B

**Preharvest interval (days):** 7

**Maximum rate:** Do not apply more than once per cutting

*Do not apply to alfalfa in the bloom period. Do not use with latex or pineolene-based adjuvants or any agricultural sticker or extender.*

## Mustang Maxx

**Rate:** 2.24-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

IRAC code: 3A

**Preharvest interval (days):** 3 for cutting or grazing

**Maximum rate:** maximum of 8 fluid oz of product per acre may be applied per cutting with a maximum 24 fluid oz of product per acre per season

## Silencer

**Rate:** 2.56-3.2 fl oz/a

**Active ingredient:** lambda-cyhalothrin

IRAC code: 3A

**Preharvest interval (days):** 7 hay, 1 forage

**Maximum rate:** Do not apply more than 0.03 lb ai (0.24 pt) per acre per cutting. Do not apply more than 0.12 lb ai (0.96 pt.) per acre per season.

## Transform WG

**Rate:** 0.75-1.0 oz

**Active ingredient:** sulfoxaflo

IRAC code: 4C

**Preharvest interval (days):** 7 for grazing, forage, fodder or hay harvest

**Maximum rate:** Do not apply more than a total of 8.5 oz per acre per year

## Warrior II

**Rate:** 1.28-1.92 fl oz

**Active ingredient:** lambda-cyhalothrin

IRAC code: 3A

**Preharvest interval (days):** 1 for forage and 7 for hay

**Maximum rate:** 0.12 lb ai/a (7.68 fl oz/a or 0.48 pt/a of Warrior II) per season

*Bee precaution: Avoid application when bees are actively foraging by applying during the early morning or during the evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. It may be advisable to remove bee shelters during and for 2-3 days following application. Avoid direct application to bee shelters.*

## Armyworm

**Threshold:** 2 larvae/sq ft

## Baythroid XL

**Rate:** 1.6-2.8 fl oz (1<sup>st</sup> – 2<sup>nd</sup> instars)

**Active ingredient:**

IRAC code:

**Preharvest interval (days):** 7

**Maximum rate:** 22.4 fl oz/a (0.175 lb ai/a) per season; 5.6 fl oz/a (0.044 lb ai/a) allowed per cutting

## Besiege

**Rate:** 6.0-10.0 fl oz

**Active ingredient:** lambda-cyhalothrin, chlorantraniliprole

IRAC code: 3A, 28

**Preharvest interval (days):** 1 day for forage and 7 days for hay.

**Maximum rate:** 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin-containing products or 0.2 lb ai of chlorantraniliprole-containing products/a/season

*Bee precaution: Make applications when bees are not actively foraging by applying during the early morning or during evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. Remove bee shelters during and for 2-3 days following application. Do not apply directly to bee shelters.*

## Declare 1.25CS

**Rate:** 1.02-1.54 fl oz

**Active ingredient:** gamma-cyhalothrin

IRAC code: 3A

**Preharvest interval (days):** 1 day for forage and 7 days for hay

**Maximum rate:** 0.06 lb ai (0.38 pt)/a/season

*Avoid application when bees are actively foraging by applying during the early morning or during evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. It may be advisable to remove bee shelters during and for 2 to 3 days following application. Avoid direct application to bee shelters.*

## Fastac EC

**Rate:** 2.8-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 3 days for cutting or grazing, 7 days of harvesting seed

**Maximum rate:** 3.8 fl oz (0.025 lb ai)/a per cutting; and a maximum of 11.4 fl oz (0.075 lb ai)/a per season

## Fastac CS

**Rate:** 2.8-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 3 days for cutting or grazing, 7 days of harvesting seed

**Maximum rate:** 3.8 fl oz (0.025 lb ai)/a per cutting; and a maximum of 11.4 fl oz (0.075 lb ai)/a per season

## Mustang Maxx

**Rate:** 2.8-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 3 for cutting or grazing

**Maximum rate:** maximum of 8 fluid oz of product per acre may be applied per cutting with a maximum 24 fluid oz of product per acre per season

## Sevin XLR Plus

**Rate:** 1.0-1.5 qt

**Active ingredient:** carbaryl

**IRAC code:** 1A

**Preharvest interval (days):** 7

**Maximum rate:** 1.5 qt/a per cutting

*Bee precaution: Do not apply to target crops or weeds in bloom.*

## Silencer

**Rate:** 2.56-3.2 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 7 hay, 1 forage

**Maximum rate:** Do not apply more than 0.03 lb ai (0.24 pt) per acre per cutting. Do not apply more than 0.12 lb ai (0.96 pt.) per acre per season.

## Warrior II

**Rate:** 1.28-1.92 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 1 for forage and 7 for hay

**Maximum rate:** 0.12 lb ai/a (7.68 fl oz/a or 0.48 pt/a of Warrior II) per season

*Bee precaution: Avoid application when bees are actively foraging by applying during the early morning or during the evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. It may be advisable to remove bee shelters during and for 2-3 days following application. Avoid direct application to bee shelters.*

## Cutworm

**Threshold:** None established

## Baythroid XL

**Rate:** 0.8-1.6 fl oz

**Active ingredient:** cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 7

**Maximum rate:** 22.4 fl oz/a (0.175 lb ai/a) per season; 5.6 fl oz/a (0.044 lb ai/a) allowed per cutting

## Belt 4SC

**Rate:** 2.0-4.0 fl oz/a

**Active ingredient:** flubendiamide

**IRAC code:** 28

**Preharvest interval (days):** 0 forage and hay

**Maximum rate:** Do not apply more than 4.0 fl oz/a/cutting. Do not apply more than 12.0 fl oz per acre (0.375 lb ai/A) per year

## Besiege

**Rate:** 5.0-8.0 fl oz

**Active ingredient:** lambda-cyhalothrin, chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 1 day for forage and 7 days for hay

**Maximum rate:** 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin-containing products or 0.2 lb ai of chlorantraniliprole-containing products/a/season

*Bee precaution: Make applications when bees are not actively foraging by applying during the early*

*morning or during evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. Remove bee shelters during and for 2-3 days following application. Do not apply directly to bee shelters.*

## Declare 1.25CS

**Rate:** 0.77-1.28 fl oz

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 1 day for forage and 7 days for hay.

**Maximum rate:** 0.06 lb ai (0.38 pt)/a/season

*Avoid application when bees are actively foraging by applying during the early morning or during evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. It may be advisable to remove bee shelters during and for 2 to 3 days following application. Avoid direct application to bee shelters.*

## Fastac EC

**Rate:** 2.2-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 3 days for cutting or grazing, 7 days of harvesting seed

**Maximum rate:** 3.8 fl oz (0.025 lb ai)/a per cutting; and a maximum of 11.4 fl oz (0.075 lb ai)/a per season

## Fastac CS

**Rate:** 2.2-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 3 days for cutting or grazing, 7 days of harvesting seed

**Maximum rate:** 3.8 fl oz (0.025 lb ai)/a per cutting; and a maximum of 11.4 fl oz (0.075 lb ai)/a per season

## Mustang Maxx

**Rate:** 2.24-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 3 for cutting or grazing

**Maximum rate:** maximum of 8 fluid oz of product per acre may be applied per cutting with a maximum 24 fluid oz of product per acre per season

## Sevin XLR Plus

**Rate:** 1.0-1.5 qt

**Active ingredient:** carbaryl

**IRAC code:** 1A

**Preharvest interval (days):** 7

**Maximum rate:** 1.5 qt/a per cutting

*Bee precaution: Do not apply to target crops or weeds in bloom*

## Silencer

**Rate:** 1.92-3.2 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 7 hay, 1 forage

**Maximum rate:** Do not apply more than 0.03 lb ai (0.24 pt) per acre per cutting. Do not apply more than 0.12 lb ai (0.96 pt.) per acre per season

## Warrior II

**Rate:** 0.96-1.6 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 1 for forage and 7 for hay

**Maximum rate:** 0.12 lb ai/a (7.68 fl oz/a or 0.48 pt/a of Warrior II) per season

*Bee precaution: Avoid application when bees are actively foraging by applying during the early morning or during the evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. It may be advisable to remove bee shelters during and for 2-3 days following application. Avoid direct application to bee shelters.*

## Grasshopper

**Threshold:**

20 per sq yd in field margins or  
8 per sq yd within alfalfa fields

## Baythroid XL

**Rate:** 2.0-2.8 fl oz

**Active ingredient:** cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 7

**Maximum rate:** 22.4 fl oz/a (0.175 lb ai/a) per season; 5.6 fl oz/a (0.044 lb ai/a) allowed per cutting

## Besiege

**Rate:** 6.0-10.0 fl oz

**Active ingredient:** lambda-cyhalothrin, chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 1 day for forage and 7 days for hay

**Maximum rate:** 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin-containing products or 0.2 lb ai of chlorantraniliprole-containing

products/a/season

*Bee precaution: Make applications when bees are not actively foraging by applying during the early morning or during evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. Remove bee shelters during and for 2-3 days following application. Do not apply directly to bee shelters.*

## Declare 1.25CS

**Rate:** 1.02-1.54 fl oz

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 1 day for forage and 7 days for hay

**Maximum rate:** 0.06 lb ai (0.38 pt)/a/season

*Avoid application when bees are actively foraging by applying during the early morning or during evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. It may be advisable to remove bee shelters during and for 2 to 3 days following application. Avoid direct application to bee shelters.*

## Fastac EC

**Rate:** 2.8-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 3 days for cutting or grazing, 7 days of harvesting seed

**Maximum rate:** 3.8 fl oz (0.025 lb ai)/a per cutting; and a maximum of 11.4 fl oz (0.075 lb ai)/a per season

## Fastac CS

**Rate:** 2.8-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 3 days for cutting or grazing, 7 days of harvesting seed.

**Maximum rate:** 3.8 fl oz (0.025 lb ai)/a per cutting; and a maximum of 11.4 fl oz (0.075 lb ai)/a per season.

## Imidan 70W

**Rate:** 1.0-1.33 lb

**Active ingredient:** phosmet

**IRAC code:** 1B

**Preharvest interval (days):** 7

**Maximum rate:** Do not apply more than once per cutting

*Do not apply to alfalfa in the bloom period. Do not use with latex or pineolene-based adjuvants or any agricultural sticker or extender.*

## Mustang Maxx

**Rate:** 2.8-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 3 for cutting or grazing

**Maximum rate:** maximum of 8 fluid oz of product per acre may be applied per cutting with a maximum 24 fluid oz of product per acre per season

## Silencer

**Rate:** 2.56-3.2 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 7 hay, 1 forage

**Maximum rate:** Do not apply more than 0.03 lb ai (0.24 pt) per acre per cutting. Do not apply more than 0.12 lb ai (0.96 pt.) per acre per season.

## Warrior II

**Rate:** 1.28-1.92 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 1 for forage and 7 for hay.

**Maximum rate:** 0.12 lb ai/a (7.68 fl oz/a or 0.48 pt/a of Warrior II) per season

*Bee precaution: Avoid application when bees are actively foraging by applying during the early morning or during the evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. It may be advisable to remove bee shelters during and for 2-3 days following application. Avoid direct application to bee shelters.*

## Plant bug

**Threshold:** On alfalfa less than 3 inches tall, treat if there are 3 adults and/or nymphs per sweep; on taller alfalfa, treat when there are 5 or more adults and/or nymphs per sweep.

## Baythroid XL

**Rate:** 1.6-2.8 fl oz

**Active ingredient:** cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 7

**Maximum rate:** 22.4 fl oz/a (0.175 lb ai/a) per season; 5.6 fl oz/a (0.044 lb ai/a) allowed per cutting

## Besiege

**Rate:** 6.0-10.0 fl oz

**Active ingredient:** lambda-cyhalothrin, chloran-

raniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 1 day for forage and 7 days for hay

**Maximum rate:** 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin-containing products or 0.2 lb ai of chlorantraniliprole-containing products/a/season

*Bee precaution: Make applications when bees are not actively foraging by applying during the early morning or during evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. Remove bee shelters during and for 2-3 days following application. Do not apply directly to bee shelters.*

## Declare 1.25CS

**Rate:** 1.02-1.54 fl oz

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 1 day for forage and 7 days for hay.

**Maximum rate:** 0.06 lb ai (0.38 pt)/a/season

*Avoid application when bees are actively foraging by applying during the early morning or during evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. It may be advisable to remove bee shelters during and for 2 to 3 days following application. Avoid direct application to bee shelters.*

## Fastac EC

**Rate:** 2.8-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 3 days for cutting or grazing, 7 days of harvesting seed

**Maximum rate:** 3.8 fl oz (0.025 lb ai)/a per cutting; and a maximum of 11.4 fl oz (0.075 lb ai)/a per season

## Fastac CS

**Rate:** 2.8-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 3 days for cutting or grazing, 7 days of harvesting seed

**Maximum rate:** 3.8 fl oz (0.025 lb ai)/a per cutting; and a maximum of 11.4 fl oz (0.075 lb ai)/a per season

## Imidan 70W

**Rate:** 1.0-1.33 lb

**Active ingredient:** phosmet

**IRAC code:** 1B

**Preharvest interval (days):** 7

**Maximum rate:** Do not apply more than once per cutting

*Do not apply to alfalfa in the bloom period. Do not use with latex or pineolene-based adjuvants or any agricultural sticker or extender.*

## Mustang Maxx

**Rate:** 2.8-4.0 fl oz/a fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 3 for cutting or grazing

**Maximum rate:** maximum of 8 fluid oz of product per acre may be applied per cutting with a maximum 24 fluid oz of product per acre per season

## Silencer

**Rate:** 2.56-3.84 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 7 hay, 1 forage

**Maximum rate:** Do not apply more than 0.03 lb ai (0.24 pt) per acre per cutting, Do not apply more than 0.12 lb ai (0.96 pt.) per acre per season.

## Transform WG

**Rate:** 1.5-2.75 oz (tarnished plant bug only)

**Active ingredient:** sulfoxaflo

**IRAC code:** 4C

**Preharvest interval (days):** 7 for grazing, forage, fodder or hay harvest

**Maximum rate:** labeled for tarnished plant bug.

Do not apply more than a total of 8.5 oz per acre per year

## Warrior II

**Rate:** 1.28-1.92 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 1 for forage and 7 for hay

**Maximum rate:** 0.12 lb ai/a (7.68 fl oz/a or 0.48 pt/a of Warrior II) per season

*Bee precaution: Avoid application when bees are actively foraging by applying during the early morning or during the evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. It may be advisable to remove bee shelters during and for 2-3 days following application. Avoid direct application to bee shelters.*

## Potato leafhopper

**Threshold:** Treat at 0.2 leafhoppers per sweep on 3 inch tall alfalfa; 0.5 per sweep on 6 inch alfalfa, 1 leafhopper

per sweep on 8-11 inch alfalfa, and 2 leafhoppers per sweep on 12-14 inch alfalfa.

## Baythroid XL

**Rate:** 0.8-1.6 fl oz

**Active ingredient:** cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 7

**Maximum rate:** 22.4 fl oz/a (0.175 lb ai/a) per season; 5.6 fl oz/a (0.044 lb ai/a) allowed per cutting

## Besiege

**Rate:** 5.0-8.0 fl oz

**Active ingredient:** lambda-cyhalothrin, chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 1 day for forage and 7 days for hay

**Maximum rate:** 31.0 fl oz of Besiege or 0.12 lb ai of lambda-cyhalothrin-containing products or 0.2 lb ai of chlorantraniliprole-containing products/a/season

*Bee precaution: Make applications when bees are not actively foraging by applying during the early morning or during evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. Remove bee shelters during and for 2-3 days following application. Do not apply directly to bee shelters.*

## Declare 1.25CS

**Rate:** 0.77-1.28 fl oz

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 1 day for forage and 7 days for hay

**Maximum rate:** 0.06 lb ai (0.38 pt)/a/season

*Avoid application when bees are actively foraging by applying during the early morning or during evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. It may be advisable to remove bee shelters during and for 2 to 3 days following application. Avoid direct application to bee shelters.*

## Fastac EC

**Rate:** 2.2-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 3 days for cutting or grazing, 7 days of harvesting seed

**Maximum rate:** 3.8 fl oz (0.025 lb ai)/a per

cutting; and a maximum of 11.4 fl oz (0.075 lb ai)/a per season

---

### Fastac CS

**Rate:** 2.2-3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 3 days for cutting or grazing, 7 days of harvesting seed

**Maximum rate:** 3.8 fl oz (0.025 lb ai)/a per cutting; and a maximum of 11.4 fl oz (0.075 lb ai)/a per season

---

### Imidan 70W

**Rate:** 1.0-1.33 lb

**Active ingredient:** phosmet

**IRAC code:** 1B

**Preharvest interval (days):** 7

**Maximum rate:** Do not apply more than once per cutting

*Do not apply to alfalfa in the bloom period. Do not use with latex or pineolene-based adjuvants or any agricultural sticker or extender.*

---

### Mustang Maxx

**Rate:** 2.24-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 3 for cutting or grazing

**Maximum rate:** maximum of 8 fluid oz of product per acre may be applied per cutting with a maximum 24 fluid oz of product per acre per season

---

### Sevin XLR Plus

**Rate:** 1 qt

**Active ingredient:** carbaryl

**IRAC code:** 1A

**Preharvest interval (days):** 7

**Maximum rate:** 1.5 qt/a per cutting

**Bee precaution:** Do not apply to target crops or weeds in bloom.

---

### Silencer

**Rate:** 2.56-3.2 fl oz/a

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 7 hay, 1 forage

**Maximum rate:** Do not apply more than 0.03 lb ai (0.24 pt) per acre per cutting. Do not apply more than 0.12 lb ai (0.96 pt.) per acre per season

---

### Warrior II

**Rate:** 0.96-1.6 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 1 for forage and 7 for hay

**Maximum rate:** 0.12 lb ai/a (7.68 fl oz/a or 0.48 pt/a of Warrior II) per season

*Bee precaution: Avoid application when bees are actively foraging by applying during the early morning or during the evening hours. Be aware of bee hazard resulting from a cool evening and/or morning dew. It may be advisable to remove bee shelters during and for 2-3 days following application. Avoid direct application to bee shelters.*

# Forage disease management

Many disease-causing organisms attack forages in Wisconsin. Any approach to plant disease control requires identification and knowledge of the cause and its life cycle, the effect of environment on disease development, and the potential control procedures available. Economic and environmental factors often determine the control procedures employed for these various diseases. Control strategies can be an integration of the following methods: planting resistant or tolerant varieties, proper crop management, and agricultural chemicals. There are a few foliar fungicides currently labeled for use in alfalfa, including Priaxor, Aproach, and Quadris (see table 4-9). Note that all of these products have very specific labels regarding use. In particular, pay close attention to the diseases that are controlled, the pre-harvest intervals within a cutting, the total number of allowed applications within a cutting period and across the whole growing season, and the application amounts allowed. We recommend consulting specific labels prior to using a product in alfalfa. Variety selection is key to disease management in forages and small grains.

The forage diseases section focuses on alfalfa (table 4-10), followed by brief sections on red clover and forage grasses.

## Alfalfa leaf and stem diseases

Although leaf and stem diseases occur in almost every alfalfa field, their severity is dependent upon periods of wet weather and/or heavy dews. While leaf and stem diseases may reduce alfalfa yields, their main effect is reducing the nutritional value of the forage. Severe leaf disease can cause excessive leaf drop; the leaves

of alfalfa plants contain much more protein and are more digestible than the stems.

Except for anthracnose, alfalfa varieties have not been characterized for reaction to leaf and stem diseases. While there are no alfalfa varieties available with documented resistance, observations indicate that varieties differ in reaction to leaf-infecting pathogens. An important cultural practice that can minimize losses due to leaf and stem diseases is harvesting in a timely manner. Many leaf diseases increase dramatically after the first flower stage. By harvesting in a timely fashion, you can avoid having to spray your crop with foliar fungicides to control diseases. Also, leaf and stem diseases can be more severe when alfalfa is seeded with a companion crop. Leaf diseases common to Wisconsin are common leaf spot, downy mildew, Stemphylium leaf spot, and Lepto leaf spot. Spring black stem and summer black stem result in leaf loss but as their names imply, are diseases of stems and crowns. Anthracnose is also a disease of stems and crowns.

## Alfalfa seedling diseases

Stand establishment failure due to seedling diseases has become more common in Wisconsin. *Aphanomyces*, *Pythium*, *Phytophthora*, and *Rhizoctonia* are the soil fungi considered to be major causes. Seeding failures are more commonly reported in fields with soils that become waterlogged for 7-14 days. In addition, many reports are associated with direct seeding. However, this may be because the development of plants established by direct seeding are more easily monitored than plants seeded with a companion crop such as oat. Often seeding failures are blamed on the companion crop from such factors as lodging.

*Phytophthora/Aphanomyces*-resistant alfalfa varieties are available and should be planted in fields that periodically have waterlogged soils. Alfalfa varieties range from highly susceptible to highly resistant to *Phytophthora* and *Aphanomyces*. No information is available on variety reactions to *Pythium* and *Rhizoctonia*. Fungicides offer some control in the early seedling phase (see table 4-11 for more information on alfalfa seed treatments).

## Alfalfa root and crown diseases

Root and crown diseases play a major role in establishment and stand longevity problems in Wisconsin. Often, low soil fertility, winter injury, and soil insects work together with disease organisms to reduce alfalfa stands. Stand losses can be minimized by planting varieties that are resistant to several diseases, and using crop management practices that minimize stress on stands. Crop rotation is of little value for control of most alfalfa diseases because most pathogens either survive indefinitely in the soil or are introduced with forage debris in seed. However, good management practices can prolong the productivity and life of plants that survive the initial infection.

- **Select disease-resistant varieties.**
- **Maintain good soil fertility.** This promotes extensive lateral root development above the diseased region of the root and extends the life of the plant.
- **Avoid untimely cuttings.** This might stress the plants. Heavy rains immediately after cutting often result in severe *Phytophthora* root rot infections. For example, do not

cut between September 1 and October 15.

- **Control leaf-feeding insects.** These can stress plants by making them more susceptible to root and crown diseases.
- **Improve surface and subsurface drainage.** Till and land-level, if practical, to reduce root and crown diseases.

### Bacterial wilt

Bacterial wilt often appears in the second or third year of the stand and can reduce stands considerably if susceptible varieties are grown. Fortunately, most alfalfa varieties have good resistance to bacterial wilt, but this can differ greatly among varieties.

### Fusarium wilt

Fusarium wilt, caused by the fungus *Fusarium oxysporum f. sp. medicaginis*, is economically damaging throughout Wisconsin but is especially a problem in sandy loam soils.

Because the pathogen survives indefinitely in the soil, crop rotation is not an effective control. Planting resistant alfalfa varieties is the only practical

**Table 4-9.** Fungicides registered for foliar alfalfa diseases in Wisconsin

Fungicide(s)	Anthrachnose	Common leaf spot	Downy mildew	Leptosphaerulina leaf spot	Powdery mildew	Rust	Spring black stem and leaf spot	Stagnospora leaf spot	Stemphullium leaf spot	Summer black stem and leaf spot	Yellow leaf blotch	Active ingredient(s)	Chemical family (FRAC code <sup>a</sup> )	Amount/use/a	Preharvest interval (PHI)
Aproach	-	4	-	x <sup>b</sup>	-	-	x	-	x	-	-	picoxystrobin	Qol (11)	6-12 fl oz	14 days
Endura	-	x	-	x	x <sup>b</sup>	-	x	-	-	-	-	boscalid	carboximides (7)	6.5 fl oz	14 days
<b>Remarks:</b> Maximum of two applications/cutting and three applications/season. Do not apply more than 19.5 fl oz/a per season.															
Fontelis	-	-	-	-	x	-	-	-	x	-	-	penthiopyrad	carboximide (7)	12-24 fl oz	14 days
<b>Remarks:</b> No more than two sequential applications before switching to a fungicide with a different mode of action. Do not exceed 48 fl oz/a/year.															
Headline EC Headline SC	x	4	x	4	x	x	x	x	x	x	x	pyraclostrobin	Qol (11)	6-9 fl oz	14 days
<b>Remarks:</b> No more than three foliar applications/year. Do not apply more than 27 fl oz/a per year.															
Kocide 2000 Kocide 3000	-	-	-	x	-	-	-	-	-	x	-	copper hydroxide	inorganic (M1)	1.5 lb 0.75 lb	0 days
<b>Remarks:</b> Do not apply more than 3.2 lb/a per season.															
Priaxor	x	6	x	5	x	x	x	x	x	x	x	fluxapyroxad + pyraclostrobin	carboximide (7) + Qol (11)	4-6.9 fl oz	14 days
<b>Remarks:</b> No more than three foliar applications/year. Do not apply more than 20.7 fl oz/a per year.															
Pristine	x	x	x	x	x	x	x	x	x	x	x	pyraclostrobin + boscalid	Qol (11) carboximides (7)	12-18 oz	14 days
<b>Remarks:</b> Do not apply more than two applications/cutting or more than three applications/growing season. Do not apply more than 54 oz/a per season.															
Quadris	x	4	x	4	x	x	x	x	x	x	x	azoxystrobin	Qol (11)	6-15.5 fl oz	14 days
<b>Remarks:</b> Do not apply more than two applications/cutting or more than three applications/growing season. Do not apply more than 54 oz/a per season.															

Efficacy ratings: Excellent = 10; very good = 8; good = 6; fair = 4; poor = 2; no control = 0; labeled, no data = x; not labeled = -

<sup>a</sup> FRAC codes indicate the modes of action for each fungicide; multiple applications of fungicides from the same group increases the chances for the fungus developing resistance.

<sup>b</sup> Suppression only.

control. Many varieties are resistant to Fusarium wilt.

### Verticillium wilt

The Verticillium wilt fungus invades the plant's vascular system and reduces the flow of water and nutrients to stems and leaves. Infected alfalfa plants may be killed either during the growing season or over winter. Verticillium wilt becomes more apparent after the second year of a stand. It is important for growers and agricultural consultants to be able to recognize Verticillium wilt and to use methods to limit its spread.

The following measures minimize the chances of introducing the fungus to an area and spreading the disease between and within fields.

- **Resistant varieties.** Alfalfa varieties differ in reaction to Verticillium wilt. Carefully select alfalfa varieties with resistance to the prevalent diseases in your area.
- **Harvesting suggestions.** Harvest recent seedings first and harvest fields at the hard-bud or early flower stage. Early harvest can limit some yield and quality losses caused by Verticillium wilt and can

slow the spread of the wilt fungus in a field.

### Phytophthora root rot

Phytophthora root rot (PRR) is a major cause of alfalfa stand depletion. PRR can kill individual plants scattered throughout the field, all plants in irregularly shaped patches, or entire fields. The disease is most severe in fields with poor internal drainage or fields where soils become saturated by excessive rainfall or irrigation.

Alfalfa varieties with high levels of PRR resistance are available to Wisconsin growers. Growers should be aware that alfalfa varieties rated PRR resistant vary greatly in extent of resistance.

PRR is often most severe in the seedling year. Seeding failures often occur if such fields are immediately replanted; occasionally alfalfa varieties with some level of resistance can fail in the seedling stage of growth. Apron (fungicide) seed treatment supplements can be used as an additional tool to manage PRR.

### Aphanomyces/Phytophthora root rot complex

*Aphanomyces* is an important water mold fungus contributing to poor alfalfa establishment and growth in wet soils. *Aphanomyces* interacts with *Phytophthora* to cause a destructive disease complex. Resistance to both pathogens is needed to improve alfalfa production in many wet soils in Wisconsin.

*Aphanomyces* causes poor plant growth, stunting and yellowing but seldom kills plants. Roots may be somewhat yellow and lack laterals and nodules, but the fungus does not cause distinct root lesions like *Phytophthora* does. When diagnosing, check cultural practices such as seed bed preparation, *Rhizobium* inoculum, and planting depth. If you've eliminated cultural practices and answer yes to these questions, then *Aphanomyces* may be the cause.

1. Have you eliminated possible atrazine or other herbicide carryover?
2. Does red clover or trefoil grow well in the site?
3. Did you plant a variety with a high level of resistance to *Phytophthora* and was it treated with mefenoxam (Apron) fungicide?

**Table 4-10.** Probability and occurrence of alfalfa diseases in stands of different ages

Disease	Harvest (established stand)				Year				
	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	seeding	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>
Anthracnose	—	moderate	high	moderate	moderate	high	high	high	high
Aphanomyces root rot	moderate	high	high	high	high	moderate	moderate	moderate	moderate
Bacterial wilt	low	low	high	high	—	low	moderate	high	high
Common leaf spot	moderate	high	high	high	high	high	high	high	high
Downy mildew	high	low	low	high	high	moderate	moderate	moderate	moderate
Fusarium crown root rot	high	high	high	high	—	low	moderate	moderate	high
Fusarium wilt	low	moderate	high	high	—	low	moderate	high	high
Phytophthora root rot	moderate	high	high	high	high	moderate	moderate	moderate	moderate
Pythium root rot	—	—	—	—	high	low	low	low	low
Spring black stem	high	moderate	—	high	moderate	high	high	high	high
Summer black stem	—	moderate	high	low	high	high	high	high	high
Verticillium wilt	high	low	moderate	high	—	low	moderate	high	high

— = none

Soils may be tested for *Aphanomyces* potential through your county Extension agent or by the Plant Disease Diagnostic Clinic (PDDC), Room 183, Russell Labs, University of Wisconsin-Madison, Madison, WI 53706.

There are two types of tests offered by the PDDC. One is a non-specific soil analysis for *Aphanomyces*, *Pythium*, or *Phytophthora*. The second is a race-specific bioassay for *Aphanomyces*. Tests may take from 2-4 weeks to complete. Contact the PDDC (608-262-2863) for specific information about the desired sample amount to conduct either test.

Alfalfa varieties are available with combined resistance to *Aphanomyces* and *Phytophthora* root rots.

Currently, there are several varieties that are resistant to race 2 of *Aphanomyces*, in addition to race 1 resistance. Use results from soil tests to select the variety with the most appropriate resistance for your field conditions.

Several new seed treatments are being evaluated in Wisconsin for the management of *Aphanomyces*. Limited research results indicate these seed treatments have some activity against the water mold. See table 4-11 for more information.

### General root and crown rot

A general root and crown rot is caused by a complex of fungi that persist in the soil; infection results in slow regrowth and stand decline.

The disease is very common in older stands but can occur in poorly managed younger stands. Although the outside of infected roots may not exhibit much rot, the core of the root and crown tissues will be rotted and have a brown-black discoloration. Infected plants are more susceptible to attack by other diseases and winter injury. Alfalfa varieties that are rated to have good winter hardiness generally show less root and crown rot. Crown and root rot can be reduced in all alfalfa varieties by maintaining high soil fertility (especially potassium) and a soil pH of 6.8-7.0, controlling leaf diseases, and not overgrazing or cutting stands between September 1 and October 15.

**Table 4-11.** Seed treatment fungicides for alfalfa diseases

Fungicide(s)	Aphanomyces root rot	Downy mildew	Fusarium seed and seedling disease	Phytophthora seed and root rot	Pythium seed and root rot	Rhizoctonia seed rot and damping off	Active ingredient(s)	Chemical family (FRAC code <sup>a</sup> )	Amount/100 lb seed	Remarks
Apron XL	-	x	-	8	8	-	mefenoxam	4	0.64 fl oz	For seedling damping-off and early season decay caused by <i>Pythium</i> and <i>Phytophthora</i> . Also provides suppression of early season seedling-borne downy mildew.
Dyna-shield Metalaxyl; Metastar ST	-	-	-	8	8	-	metalaxyl	4	0.75–1.5 fl oz	For seedling damping-off and early season decay caused by <i>Pythium</i> and <i>Phytophthora</i> .
Rizolex	3	-	-	x	x	-	tolclofos-methyl	14	0.3 fl oz	For protection against seed and seedling decay caused by various soilborne fungi and oomycetes. May provide suppression against <i>Aphanomyces</i> root rot. Do not apply more than 200 lb of seed treated with Rizolex per acre.
Stamina	4	-	x	x	-	5	pyraclostrobin	11	1.5–3.1 fl oz	For protection against seed and seedling decay caused by various soilborne fungi and oomycetes. May provide suppression against <i>Aphanomyces</i> root rot.

Efficacy ratings: 10 = excellent; 8 = very good; 6 = good; 4 = fair; 2 = poor; 0 = no control

Key: x = labeled, no data; - = not labeled

<sup>a</sup> FRAC codes indicate the modes of action for each fungicide; multiple applications of fungicides from the same group increases the chances for the fungus developing resistance.

## Red clover diseases

Red clover, like alfalfa, has diseases that attack leaves, stems, and roots, reducing yield, quality, and stand life. The prevalent leaf and stem diseases can be controlled by planting resistant or tolerant varieties. Cutting the crop at late bud or early bloom also can help minimize leaf and stem diseases. Root rots of red clover cause depletions of stands. Stand decline can be reduced by planting varieties with good winter hardiness and maintaining high soil fertility (especially potassium).

### Crown and root rots

Crown and root rots can cause serious stand decline in red clover. Several soil fungi can be the cause of this problem. Infected plants often are stunted or wilted. The roots of these plants are rotted (dark brown-black) on the outside and in the central core of the plants. The disease is most damaging when the rot progresses into the crown. Infected plants are prone to winterkill. Winter injury in turn can lead to severe root and crown rot. Varieties such as Arlington or Marathon that have good resistance to northern anthracnose and powdery mildew are strongly recommended. Such resistance also increases winter survival, making them better able to combat the effects of root and crown rot. Root and crown rot also can be reduced by maintaining good soil fertility (especially potassium).

### Northern anthracnose

Northern anthracnose can reduce yields and quality of red clover in stands of all ages. Resistant varieties are available.

### Powdery mildew

Powdery mildew forms a white powdery mass of mold on the upper surface of the leaves. Most newer varieties are resistant to powdery mildew.

## Viruses

Viruses in red clover are recognized by a green-and-yellow mosaic pattern that develops on leaves. Viral symptoms can be confused with symptoms of nutrient deficiencies. Red clover varieties differ in reaction to bean yellow mosaic virus. Reaction to other viruses is not known.

## Diseases of forage grasses

Common diseases of forage grasses are leaf rust, stem rust, leaf spot, and root rot. Rusts are recognized by round, bright orange pustules that rupture the leaf tissues (leaf rust) or oblong, reddish-brown pustules that rupture stem tissues (stem rust). Leaf spot diseases differ from the rusts in that they do not rupture the plant tissues. Most leaf spots are characterized by brown-to-black spots that are bordered by a yellow halo. Root rots cause brown-to-black roots that are reduced in number and size. A disease called ergot can develop in the heads of forage grasses. Long, hard, black fungal structures are scattered in the heads and replace the grain where they form. These ergot bodies can cause health problems if consumed by livestock.

Ergot can be reduced by cutting forage grasses early and clipping wild grasses along the edges of fields. Rust and leaf spot diseases can be reduced by harvesting the crop as early as possible and planting resistant or tolerant varieties.



Principles of pest  
management

Corn weeds

Soybean

Forages &  
pastures

# SMALL GRAINS PEST MANAGEMENT

Stored grain  
insects

Appendix

# Small grains weed management

A sound weed management program often uses mechanical weeding to maximize the effectiveness of an herbicide treatment. However, small grains are sown in narrow rows, making cultivation after planting impossible. Consequently, cultural practices such as crop rotation, adapted varieties, adequate fertilization, crop competition, and clean seed will maximize weed control. Fewer herbicide alternatives are available for weed control in small grains than for most other crops (see table 5-1). Therefore, producers must use all possibilities in an integrated approach for effective weed management.

Fall-seeded small grains are very competitive with weeds. Winter wheat, for example, seldom needs an herbicide treatment. The exception is with winter annual weeds like horseweed (aka maretail) shepherd's purse and pennycress that emerge with wheat in the fall. Check fields regularly after seeding and be ready to treat if and when needed.

Many producers apply nitrogen to winter wheat and often ask about using liquid fertilizer as the carrier to simultaneously apply the herbicide. This approach would save a trip over the field but has two limitations. First, nitrogen is most effective when applied early in the spring, often before green-up, while most herbicides are applied between Feekes stages 4 and 8. Postponing the fertilizer application will reduce small grain yield. The other concern is that liquid fertilizers applied at these growth stages may result in leaf burn to the cereal, especially if applied under hot, humid conditions. This risk is particularly high for herbicides like Harmony SG that require a surfactant in the spray solution. Thus, we discourage applying herbicides in liquid fertilizer in small grains.

It's important to measure the growth stage of cereals before using post-emergence herbicides. Figure 5-1 shows this relationship using the Feekes scale, which gives a numerical value to 11 developmental stages.

For a summary of harvest and grazing intervals following herbicide use in small grains, refer to table 5-2.

## Herbicides for small grains with a legume seeding

Spring-seeded small grains often have alfalfa seeded with them. This greatly limits the use of herbicides. If weeds are abundant, harvesting the small grain as silage is an excellent practice because it kills weeds before they produce seeds, harvests weeds while they still have relatively good feed value, and greatly increases the likelihood of successfully establishing the legume. Interest in frost-seeding red clover into winter wheat is growing in Wisconsin. As with alfalfa seeded into oats, weeds are usually not an important factor after frost seeding, but in situations where broadleaf weeds are abundant, two herbicide options are available.

### Brox 2EC bromoxynil (6)

**Rate:** 1.0-1.5 pt/a (consult the label to determine rate for specific weed species)

**Adjuvants:** Do not add surfactants or other additives to the spray mixture.

**Timing: POST.** Treat when small grains have several leaves and up to the boot stage, when alfalfa has at least 4 trifoliate leaves, and when weeds are small.

**Remarks:** This product can be used in small grains alone or with an underseeding of alfalfa but not on red clover or any other legume. Brox 2EC controls many broadleaf weeds that may occur in companion crop seedings, particularly shepherd's purse, pennycress, wild mustard, and wild radish. Apply Brox 2EC in at least 20 gal/a of water. Applications of Brox 2EC to underseeded oats may result

in serious alfalfa injury if the temperature on the day of application or in the 3 days after application exceeds 70°F. Temperatures above this limit will be more likely to cause serious injury if the relative humidities are high on the day of treatment.

### MCPA (4)

**Rate:** Apply 0.33-0.5 pt/a of MCPA amine (forms containing 4 lb ae/gal). When using products containing other than 4 lb ae/gal, adjust rates accordingly to apply 0.17-0.25 lb ae/a.

**Adjuvants:** Do not add surfactants or other additives to the spray mixture.

**Timing: POST.** Treat when small grain is tillered and has four or more leaves but before the jointing stage. The legume should be 2-3 inches tall.

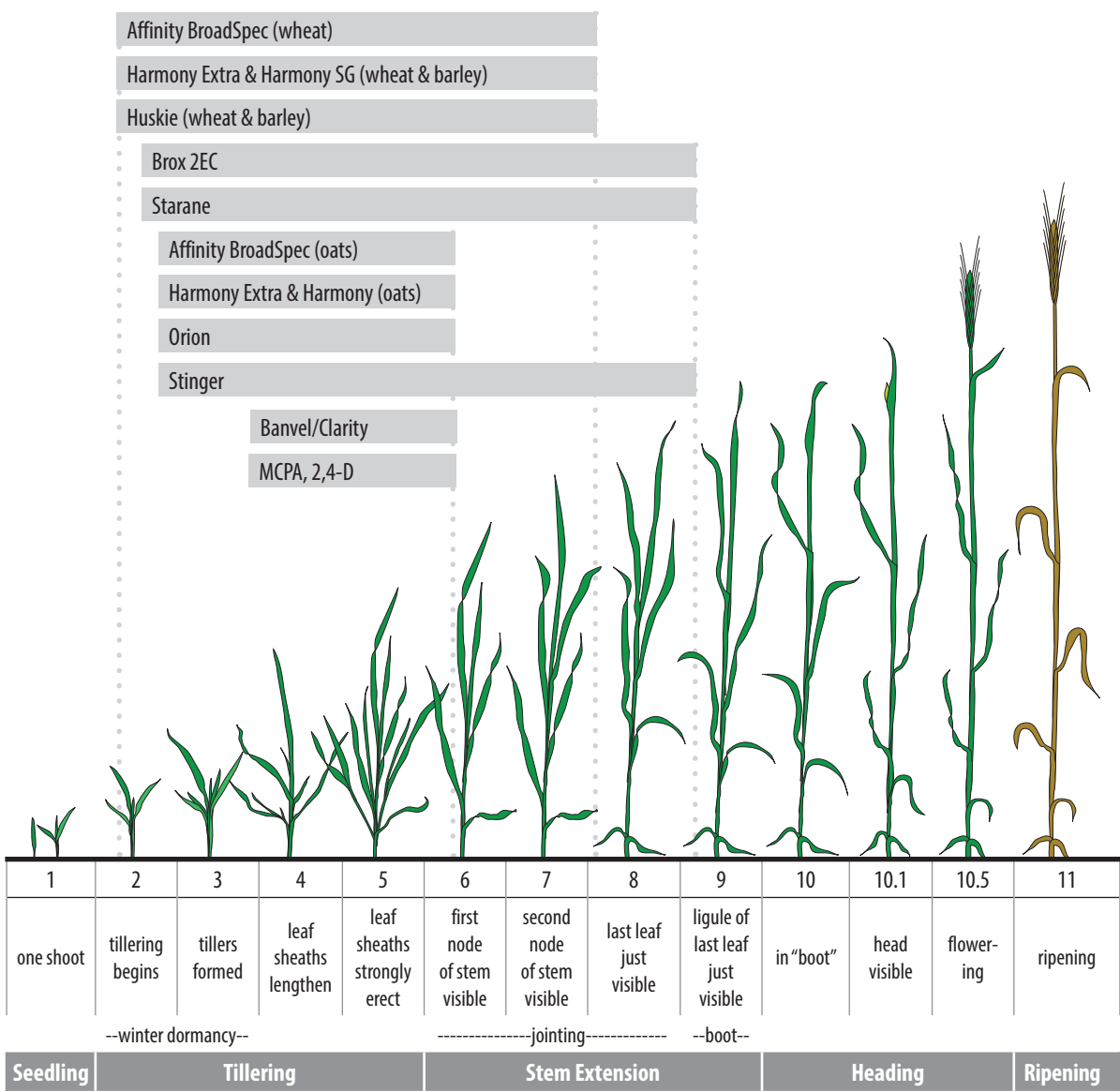
**Remarks:** Never use the ester formulations of MCPA in companion crop seedings as the legume will be killed. Legume stands of alfalfa; trefoil; or red, alsike, white, or ladino clover are usually not severely injured at this rate or time of application. MCPA amine labels caution that the product should not be used unless some legume injury can be tolerated. Some brands of MCPA do not carry label directions for use on small grain undersown with a small seeded legume. Using brands without label directions for this use is illegal. A well-developed small grain and weed canopy of leaves is necessary to provide a protective "umbrella" over the legume seedlings to minimize herbicide contact with the legume. Sometimes, under ideal growing conditions, legume seedlings grow almost as rapidly as the small grain and such a protective canopy never develops. Do not apply MCPA when legume seedlings are as tall or nearly as tall as the small grain or when the oat and weed canopy does not cover the alfalfa seedlings. Excessive exposure to the herbicide treatment will almost certainly result in severe legume damage. Use less than 6 gal/a of water and low pressure when applying MCPA to reduce risk of legume injury. Broadleaf weeds are more easily controlled as seedlings than when they begin to flower.

### Choosing between Brox 2EC and MCPA

The factors to consider in choosing between these two products are temperature and relative humidity at and after time of treatment, degree of protection to the legume by the small grain and weed canopy, the

specific weed species present, and the growth stage of the alfalfa and cereal. For example, Brox 2EC is most indicated when lambsquarters, smartweeds, or wild buckwheat are present, temperatures are 70°F or less, and alfalfa has four or more trifoliate leaves. MCPA is the better choice if pigweed is the dominant weed, temperatures exceed 70°F, humidities are high, and the oats and weeds protect the alfalfa seedlings.

**Figure 5-1.** Herbicide application periods at various growth stages of small grains (Feekes scale)



## Feekes Scale

Source: Adapted and used with permission from Michigan State University Extension publication *Weed Control Guide for Field Crops* (E-434)

**Table 5-1.** Crop registration, tolerance, and herbicide effectiveness on weeds commonly found in small grains

Herbicide	Cereals registered	Site of action group <sup>a</sup>	Can be underseeded?	Cereal crop tolerance	Annual grass weeds	Broadleaves														
						Annual												Perennial		
						Common chickweed	Common ragweed	Giant ragweed	Lambsquarters	Pennycress	Pigweed	Prickly lettuce	Shepherd's purse	Smartweeds	Wild buckwheat	Wild mustard	Wild radish	Canada thistle	Field bindweed	Perennial sow thistle
2,4-D amine	all	4	no/yes <sup>b</sup>	8	0	6	9	8	10	10	10	9	10	5	6	9	9	6	6	6
Affinity BroadSpec	B,W	2	no	9	0	8	8	5	9	10	10	8	10	8	8	10	7	8	5	6
Banvel/Clarity	B,O,W	4	no	7	0	8	8	8	9	6	9	8	6	9	9	6	6	6	6	7
Brox 2EC	all	6	A	8	0	5	8	7	9	8	7	6	10	8	9	8	8	5	5	0
Callisto	O	27	no	9	0	8	7	7	10	10	10	—	10	10	5	8	—	5	5	—
Harmony Extra	B,O,W	2	no	9	0	8	8	5	9	10	10	8	10	8	8	10	7	8	5	6
Harmony SG	B,O,W	2	no	9	0	6	6	5	10	10	10	6	10	8	6	10	6	5	5	5
Huskie	B,W	6, 27	no	9	0	9	8	8	10	10	9	9	9	9	9	9	9	6	6	8
Huskie Complete	W	2, 27, 6	no	9	9	9	8	8	10	10	9	9	9	9	9	9	9	6	6	8
MCPA amine	all	4	A, RC	8	0	6	8	8	8	10	8	9	10	5	6	9	9	6	6	6
Orion	B,O,W	2, 4	no	8	0	8	8	6	8	8	8	6	8	8	8	8	—	5	5	6
Starane	B,O,W	4	no	9	0	8	9	—	5	7	5	8	—	—	7	7	—	5	7	5
Stinger	all	4	no	10	0	5	9	9	0	5	0	9	5	6	7	0	0	9	5	6
Talinor	B,W	6, 27	no	9	4	7	9	8	9	9	9	9	9	8	8	9	9	6	6	8
Wolverine Advanced	B,W	1, 6, 27	no	9	9	9	8	8	10	10	9	9	9	9	9	9	9	6	6	8

Abbreviations: A = alfalfa; B = barley; O = oats; RC = red clover; W = wheat

Efficacy ratings: 10 = excellent; 8 = good; 6 = fair; 4 = poor; 0 = none; — = insufficient information

<sup>a</sup> Weed Science Society of America-approved group numbers for the corresponding herbicide site of action.

<sup>b</sup> Some brands of 2,4-D amine allow application in underseeded small grains. We do not recommend it because the risk of legume injury is very high.

Principles of pest management

Corn weeds

Soybean

Forages & pastures

Small grains weeds

Stored grain insects

Appendix

## Herbicides for small grains without a legume seeding

### 2,4-D (4)

**Rate:** Apply 1.0 pt/a of 2,4-D amine or 0.67 pt/a of 2,4-D ester (forms containing 3.8 lb ae/gal) in wheat, rye, or barley. Apply 0.5-1.0 pt/a of 2,4-D amine or 0.5 pt/a of 2,4-D ester in oats.

**Adjuvants:** Do not add surfactants or other additives to the spray mixture. Nitrogen fertilizer may be used as the carrier instead of water.

**Timing: POST.** Treat when cereals are fully tillered (usually 4-8 inches tall) and before the jointing stage; never treat in the boot or dough stages.

**Weeds:** Treat when annual broadleaves are 4 inches or less in height.

**Remarks:** When using forms of these herbicides containing other than 3.8 lb ae/gal, adjust rates accordingly. Apply 2,4-D before the small grain reaches the jointing stage of development. Applications after jointing occasionally cause yield loss.

**Note:** Do not treat grains in the boot to dough stage because of the risk of severe yield loss. Susceptible broadleaf weeds are usually controlled by the lower rates, but less susceptible weeds require full dosage. Smartweed and pennycress are best controlled by 2,4-D ester, but amine is less likely to injure small grains. 2,4-D amines are usually water soluble liquids while 2,4-D esters are emulsifiable concentrates. 2,4-D is sold under various trade names and at various concentrations of acid equivalence. Be sure to read and follow the guidelines on the label for your brand of 2,4-D as there are often labeling differences between manufacturers. Wheat, barley, oats, and rye grain from fields treated with 2,4-D amine or ester may be used for any purpose.

**Rotational restrictions:** Corn may be planted 7-14 days after 2,4-D application; soybeans may be planted after 7-30 days; other crops can be planted after 3 months.

**Affinity BroadSpec** thifensulfuron (2) + tribenuron (2)

**Rate:** Use 0.4-1.0 oz/a in wheat or barley; 0.4 oz/a in oats. Rates of 0.4-0.6 oz/a must be tank mixed with other herbicides.

**Adjuvants:** Add nonionic surfactant at 0.25% of spray solution. See label for surfactant rates when mixing other herbicides with Affinity BroadSpec. Ammonium sulfate at 2 lb/a or 2 qt/a of nitrogen fertilizer may also be added.

**Timing: POST.** Apply from the 2-leaf stage, but before the flag leaf is visible in wheat and barley. Apply from the 3-leaf stage but before the jointing

stage in oats.

**Weeds:** Treat annual weeds before they are 4 inches tall or wide. Treat 4- to 8-inch Canada thistle in the spring.

**Remarks:** Affinity BroadSpec is a premix of a 1:1 ratio of Harmony SG and Express, which provides a higher rate of Express than in Harmony Extra. Affinity BroadSpec controls many species of mustards, including wild mustard, shepherd's purse, and pennycress, and also pigweed, lambsquarters, henbit, and smartweeds. Wild buckwheat should be controlled with a 0.8 oz/a rate. Common ragweed control is inconsistent and giant ragweed is not adequately controlled. To ensure adequate control of common ragweed, tank mix with 2,4-D. When treating Canada thistle, tank mix 0.8 oz/a with 2,4-D or dicamba. Brox 2EC and Starane are also labeled for tank mixtures. 2,4-D is a likely partner as Affinity BroadSpec will improve wild buckwheat and smartweed control compared to 2,4-D alone. Affinity BroadSpec can be tank mixed with insecticides or fungicides.

Apply in at least 5 gal/a of water with flat fan nozzle tips and in at least 10 gal/a with flood jet tips. Nitrogen fertilizer may be used as the carrier instead of water. Allow at least 45 days following application before harvest. Straw from treated small grains may be used for bedding or feed.

**Rotational restrictions:** Wheat and barley can be replanted any time after application, soybeans can be planted after 7 days, and corn can be planted after 14 days. Any other crop can be planted 45 days after an application of Affinity BroadSpec, except canola or beets, which require a 60-day interval.

### Banvel/Clarity

See dicamba (2).

**Brox 2EC** bromoxynil (6)

**Rate:** Apply 1.0-2.0 pt/a

**Adjuvants:** Do not add surfactants or other additives to the spray mixture.

**Timing: POST.** Base timing on the stage of weed growth but do not treat small grains in or beyond the boot stage.

**Weeds:** Apply when weeds in winter wheat have no more than 8 leaves or when weeds in spring-seeded cereals have 4 leaves and when weeds in either seeding time are no more than 2 inches tall.

**Remarks:** Brox 2EC controls many broadleaves commonly found in small grains, especially shepherd's purse, pennycress, lambsquarters, wild radish, wild mustard, and yellow rocket seedlings. This treatment only controls seedling weeds when spray coverage is thorough and uniform. It will not

control perennial weeds like Canada thistle. Apply Brox 2EC with flat fan nozzles using at least 10 gal/a of water and 30 psi pressure.

Brox 2EC can be applied to wheat, barley, rye, and oats and tank mixed with MCPA or 2,4-D for any of these cereals. It can be tank mixed with dicamba, Express, or Harmony Extra only for use in winter and spring wheat. Do not apply if crops are under stress or if the weeds are protected by a crop canopy. Treated areas cannot be grazed for 45 days.

**Rotational restrictions:** Corn can be planted any time after Brox 2EC application. Other crops can be planted after 30 days.

**Callisto** mesotrione (27)

**Rate:** 6 fl oz/a preemergence or 3 fl oz/a postemergence

**Adjuvants:** For postemergence applications, add crop oil concentrate at 1% or nonionic surfactant at 0.25%. The addition of 28% nitrogen solution at 2.5% or ammonium sulfate at 8.5 lb/100 gal may increase weed control, but may also increase the risk of injury.

**Timing: PRE.** Apply after planting oats and before weed emergence.

**POST.** Apply to oats before weeds exceed 5 inches in height. Do not apply within 50 days of harvest.

**Remarks:** Callisto has a supplemental label allowing these applications. Callisto controls many annual broadleaf weeds and cannot be used on oats underseeded with alfalfa. A preemergence application should provide greater crop safety than postemergence applications. Tank mixing emulsifiable concentrate formulations of other pesticides with postemergence applications is not recommended because of the risk of injury. Only one Callisto application can be made per year.

**Rotational restrictions:** Small grains can be planted 120 days after application. Alfalfa, soybeans, potatoes, and tobacco can be planted after 10 months. Other crops cannot be planted until 18 months after treatment.

### Dicamba (4)

**Rate:** Apply 2-4 fl oz/a of either Banvel or Clarity in wheat or spring oats; 2-3 fl oz/a in spring barley.

**Adjuvants:** Do not add surfactants or other additives to the spray mixture.

**Timing: POST.** Apply to winter wheat in spring after winter dormancy and before joint stage or to spring-sown wheat or oats in the 2- to 5-leaf stage, and to spring-seeded barley in the 2- to 4-leaf stage.

**Weeds:** Treat when weeds are in the 2- to 3-leaf stage and rosettes are less than 2 inches across.

**Remarks:** Carefully monitor crop development and

treat only at recommended growth stages. Later application may injure small grains and reduce yield. Dicamba controls many broadleaf weeds and is particularly effective on smartweed and wild buckwheat. This herbicide will also kill legumes—never use it on small grain undersown with a legume seeding. Since most of Wisconsin's small grain is grown with an undersown legume, use of dicamba or dicamba combinations in small grain (especially oats) will be very limited.

Dicamba is weak on weeds in the mustard family and very effective on wild buckwheat and smartweed. Dicamba can be tank mixed with 2,4-D, MCPA, Brox 2EC, Express, or Harmony Extra in winter wheat and winter barley to broaden the spectrum of weeds controlled. In spring-seeded barley, Brox 2EC, Express, Harmony Extra, or MCPA can be tank mixed with dicamba; in spring-seeded oats, only MCPA can be tank mixed with dicamba. Oats are more tolerant to dicamba than wheat and barley. Do not treat barley unless some injury is acceptable.

Crop staging and proper application timing are critical to avoid injuring small grains with dicamba. Do not use even low rates of dicamba after the small grain has developed beyond the recommended growth stage. Be particularly cautious with early developing wheat varieties like Madison and Wakefield.

**Rotational restrictions:** Corn can be planted any time after dicamba application. Other crops can be planted after harvest.

### Harmony Extra SG thifensulfuron (2) + tribenuron (2)

**Rate:** Use 0.45-0.9 oz/a in wheat and barley; 0.45-0.6 oz/a in oats. (Rates of new Harmony Extra SG are 50% higher than the original Harmony Extra.)

**Adjuvants:** Add a nonionic surfactant at 0.25% of spray solution. Ammonium sulfate at 2 lb/a or 2 qt/a of nitrogen fertilizer may also be added. See label for surfactant rates when mixing other herbicides with Harmony Extra.

**Timing: POST.** Apply Harmony Extra to wheat or barley with 2 leaves but before the flag leaf is visible. Treat oats after the crop has 3 leaves but before the jointing stage.

**Weeds:** Treat annual weeds after emergence and before they are 4 inches tall or wide; treat 4- to 8-inch Canada thistle in the spring.

**Remarks:** Harmony Extra, a premix of Harmony SG and Express, controls many species of mustards, including wild mustard, shepherd's purse, pennycress, and wild radish, and also pigweed, lambsquarters, henbit, kochia, and smartweed. Common ragweed control is inconsistent and giant ragweed is not adequately controlled. To ensure adequate control

of wild radish or common ragweed, mix Brox 2EC, MCPA, or 2,4-D with Harmony Extra. When treating Canada thistle, mix 2,4-D with Harmony Extra. If appropriate, dicamba can also be tank mixed with Harmony Extra.

Do not apply more than 0.6 oz/a of Harmony Extra to oats, nor more than 0.9 oz/a to wheat and barley. Small grain varieties vary in tolerance to Harmony Extra. Do not use this product in the oat varieties Ogle, Porter, or Premier.

Apply Harmony Extra in at least 5 gal/a of water with flat fan nozzle tips and in at least 10 gal/a with flood jet tips. Nitrogen fertilizer may be used as the carrier instead of water. Follow label instructions carefully to prevent drift and to properly clean the sprayer after treatment. Tank mixes with dicamba may reduce control of some broadleaf weeds and combinations with Brox 2EC may reduce Canada thistle control. Do not harvest within 45 days of application. Straw from treated small grains may be used for bedding or feed.

**Rotational restrictions:** Wheat, barley, and oats can be replanted at any time. Any other crop can be planted 45 days after applying Harmony Extra.

### Harmony SG thifensulfuron (2)

**Rate:** Use 0.45-0.9 oz/a in wheat and barley; 0.45-0.6 oz/a in oats

**Adjuvants:** Add a nonionic surfactant at 0.25-0.5% of spray solution. Ammonium sulfate at 2 lb/a or 2 qt/a of nitrogen fertilizer may also be added. See the label for surfactant rates when tank mixing with other herbicides.

**Timing: POST.** Apply Harmony after wheat or barley is in the 2-leaf stage but before the flag leaf is visible; treat oats when the crop is in the 3-leaf stage but before jointing.

**Weeds:** Treat when broadleaf weeds are 1-4 inches tall.

**Remarks:** Harmony controls several common annual broadleaves in winter wheat, barley, and oats. These include most weeds in the mustard family, pigweed, lambsquarters, chickweeds, smartweeds, mayweed, pineappleweed, and annual sowthistle. If mixed with other herbicides, it controls prickly lettuce and wild radish. Harmony can be tank mixed with 2,4-D, dicamba, or Brox 2EC to broaden the spectrum of weeds controlled. Small grain varieties vary in sensitivity to Harmony; do not use this product on the oat varieties Ogle, Porter, or Premier. Harmony SG may be tank mixed with insecticides or fungicides. Do not apply Harmony when the cereals are under environmental stress.

Apply Harmony in 10-25 gal/a of water. Nitrogen fertilizer may be used as the carrier instead of water. Straw from treated small grains may be used for bedding or feed.

**Rotational restrictions:** Wheat, barley, oats, and field corn may be planted any time after applying Harmony. Any other crop may be planted 45 days after application.

### Huskie pyrosulfotole (27) + bromoxynil (6) + safener

**Rate:** 11-15 fl oz/a (11 fl oz/a is the standard rate)

**Adjuvants:** Add 0.5-1 lb/a ammonium sulfate or 1-2 qt/a of 28% nitrogen solution. Nonionic surfactant at 0.25% may be added if required by a tank-mix partner.

**Timing: POST.** Apply from 1-leaf stage up to flag leaf emergence.

**Weeds:** Treat actively growing weeds before they have more than 4-6 leaves or are more than 4 inches in diameter.

**Remarks:** Huskie controls many annual broadleaf weeds and will suppress some perennial broadleaf weeds in wheat and barley. If needed, Huskie can be tank mixed with other small grain herbicides. Apply Huskie in 10 gal/a of water or more to achieve thorough spray coverage as these ingredients primarily have contact activity. Nitrogen fertilizer may be used as the carrier instead of water when winter wheat is treated. Huskie is rainfast in 1 hour. Do not graze or harvest forage for 25 days after application or harvest grain for 60 days after application.

**Rotational restrictions:** Small grains can be replanted 7 days after application; soybeans after 4 months; and alfalfa, dry beans, corn, and potato after 9 months. A field bioassay is required before planting crops not listed on the label.

### Huskie Complete thien carbazon (2) + pyrosulfotole (27) + bromoxynil (6) + safener

**Rate:** 13.7 fl oz/a

**Adjuvants:** Add 0.5-1 lb/a ammonium sulfate or 1-2 pt/a of 28% nitrogen solution. Nonionic surfactant at 0.25% may be added if required by a tank-mix partner.

**Timing: POST.** Apply from 1-leaf stage up to 70 days prior to harvest.

**Weeds:** Treat actively growing weeds before grass weeds have their second tiller and when broadleaf weeds have between 1-6 leaves.

**Remarks:** Controls most annual grass and broadleaf weeds in wheat. If needed, it can be tank mixed with Express, MCP Ester, or Olympus. Check the label for additional restrictions.

**Rotational restrictions:** Wheat can be replanted three months after application but others are nine months (corn, peas, soybeans, alfalfa). Some are even eighteen months (see label). Where a crop is not specified on the label, a field bioassay is required before planting crops.

## MCPA (4)

**Rate:** Apply 0.5–1.0 pt/a of MCPA amine or MCPA ester (formulations containing 4 lb ae/gal).

**Adjuvants:** Do not add surfactants or other additives to the spray mixture.

**Timing: POST.** Apply in spring after grain has four leaves and before jointing stage. Do not apply in boot to dough stage.

**Remarks:** Apply MCPA when small grain is fully tillered (usually 4–8 inches tall). The risk of crop injury increases as the rate increases. Apply MCPA with a minimum of 10 gal/a of water. MCPA amine is soluble in water while MCPA ester is an emulsifiable concentrate. MCPA is sold under various trade names and at various concentrations of acid equivalence. Be sure to read and follow the guidelines on the label for your brand of MCPA as there are often labeling differences between manufacturers. Wheat, barley, oats, and rye grain from fields treated with MCPA may be used for any purpose.

**Rotational restrictions:** The label gives no information on planting rotational crops.

## Orion florasulam (2) + MCPA (4)

**Rate:** 17 fl oz/a

**Adjuvants:** The addition of 0.2% nonionic surfactant is suggested.

**Timing: POST.** Apply from 3-leaf stage up to jointing. Applications from jointing until boot stage may cause injury.

**Weeds:** Treat actively growing weeds when 1–4 inches tall.

**Remarks:** Orion is labeled to control many mustards such as shepherd's purse, field pennycress, and wild mustard as well as common chickweed, lambsquarters, pigweed, common ragweed, wild buckwheat, and smartweeds. Apply in 8 or more gal/a water. Orion is rainfast in 4 hours. Treated small grains can be grazed in 7 days.

**Rotational restrictions:** Small grains can be planted 14 days after application; corn can be planted after 3 months; alfalfa, dry beans, potatoes, and soybeans can be planted after 9 months; all other crops can be planted after 12 months.

## Starane fluroxypyr (4)

**Rate:** 0.67 pt/a

**Adjuvants:** Do not add surfactants or other additives to the spray mixture.

**Timing: POST.** Apply Starane to actively growing wheat, oats, or barley from the 2-leaf growth stage up to and including flag leaf emergence. Treat at least 40 days before harvest.

**Weeds:** Treat actively growing annual weeds before they exceed 8 inches in height; treat hemp dogbane when it is 12–18 inches tall.

**Remarks:** Starane controls several broadleaf weeds in wheat, oats, and barley. Susceptible species include hemp dogbane, chickweed, kochia, common ragweed, and bedstraw. Starane is particularly effective on hemp dogbane; fields with this weed could be rotated to wheat and treated with Starane to reduce the infestation. This product also suppresses pennycress, mustard, wild buckwheat, and field bindweed. Up to 1.33 pt/a of Starane could be applied to these latter weeds but it is probably better to tank mix Starane with other broadleaf herbicides to improve and broaden the spectrum of control to include additional weeds. Control will be reduced if weed foliage is wet at the time of application. Never use Starane in fields underseeded with legumes as they would be killed. Starane is available as an emulsifiable concentrate with 1.5 lb ae fluroxypyr/gal.

**Rotational restrictions:** Only wheat, barley, and oats can be replanted sooner than 120 days after application. All other crops can be planted after 120 days.

## Stinger clopyralid (4)

**Rate:** 0.25–0.33 pt/a

**Adjuvants:** Do not add surfactants or other additives to the spray mixture.

**Timing: POST.** Apply Stinger to wheat, barley, or oats after the 3-leaf but before the boot stage.

**Weeds:** Treat Canada thistle in the rosette to early bud stage and annual broadleaves with 2–5 leaves.

**Remarks:** Stinger controls several broadleaf weeds in wheat, barley, and oats. It is weak on smartweed and does not control weeds in the mustard family or lambsquarters. Stinger is labeled for several weeds in the composite family, including giant and common ragweed and Canada thistle. For Canada thistles, use 0.33 pt/a and treat as the cereal reaches the early boot stage. Never use Stinger in fields underseeded with legumes. Weeds should be actively growing when treated; do not add a surfactant or crop oil to the spray solution. Do not use in fields that will be summer seeded to alfalfa. Also avoid using in areas where the groundwater is vulnerable to contamination due to very permeable

soils and/or a very shallow water table. Stinger can be tank mixed with Brox 2EC, dicamba, MCPA, or 2,4-D.

**Rotational restrictions:** Treated fields can be planted to wheat, barley, oats, grasses, or field corn any time after application. Alfalfa, soybeans, dry beans, and sunflowers can be planted 10.5 months after application. Do not plant other crops within 18 months unless risk of some crop injury is acceptable.

## Talinor bicyclopyrone (27) + bromoxynil (6)

**Rate:** 13.7 to 18.2 fl oz/A

**Timing: POST.** Talinor can be applied to all varieties of winter and spring wheat and barley from the 2-leaf stage to pre-boot stage.

**Adjuvants:** Always add the directed rate of CoAct+ to the spray solution (see label for details). In addition, add COC (1% v/v) or NIS (0.25%). Do not add AMS containing products to the spray mixture as severe crop injury may occur.

**Remarks:** Talinor provides postemergence control of many broadleaf weeds. Talinor can be tank-mixed with many herbicides to broaden the weed control spectrum (see label).

## Wolverine Advanced fenoxaprop (1) + pyroxasulfone + bromoxynil (6) + safener

**Rate:** 1.7 fl oz/a

**Adjuvants:** Add 0.5–1 lb/a ammonium sulfate or 1–2 pt/a of 28% nitrogen solution.

**Timing: POST.** Apply from 1-leaf stage up to 70 days prior to harvest.

**Weeds:** Treat actively growing weeds before grass weeds have their second tiller and when broadleaf weeds are between 1–6 leaves.

**Remarks:** Controls most annual grass and broadleaf weeds in wheat.

**Rotational restrictions:** Small grains can be replanted one month after application; corn, peas, soybeans and alfalfa, sorghum and soybeans after four months; and corn, potatoes, and peas after nine months. Read label for directions for planting alfalfa to ensure within compliance. Where a crop is not specified on the label a field bioassay is required before planting.

**Table 5-2.** Harvest and/or grazing restrictions for herbicides registered for use in small grains<sup>a</sup>

Herbicide	Use(s)	Animal type	Interval between application and grazing or harvest	Comments
2,4-D	small grains	all	2-week grazing restriction	—
	small grains, preharvest	all	7 days before harvest	Do not feed straw to livestock.
Affinity BroadSpec	wheat, barley	all	7 days for grazing or forage; 45 days before harvest	Allow 30 days between application and hay harvest.
Brox 2EC	small grains	all	45 days	Do not harvest summer-seeded alfalfa treated with Brox until following spring.
Callisto	oats	all	30 days for grazing or forage; 50 days before harvest	—
Dicamba	small grains	non-lactating, lactating	0 days	Do not harvest hay within 37 days after treatment.
Harmony Extra	wheat, barley	all	7 days for grazing or forage; 45 days before harvests	Allow 30 days between application and hay harvest.
Harmony SG	wheat, barley	all	7 days for grazing or forage; 45 days before harvest	Allow 30 days between application and hay harvest.
Huskie	wheat, barley	all	25 days for grazing or forage; 60 days for grain or straw	—
Huskie Complete	wheat	all	25 days for grazing; 30 days for hay; 70 days for grain or straw	—
MCPA	small grains	all	—	Do not allow livestock to graze treated fields within 7 days of slaughter.
Orion	small grains	all	7 days for grazing; 60 days before harvest	—
Roundup PowerMAX <sup>b</sup>	wheat, barley preharvest	—	7 days	Apply only when grain is in hard dough stage (30% moisture or less).
Starane	small grains	all	7 days for grazing; 40 days before harvest	—
Stinger	small grains	all	7 days	Do not harvest hay from treated grain fields.
Talinor	wheat, barley	all	30 days for for grazing or forage; 60 days before grain harvest.	Do not feed wheat or barley straw to livestock for a minimum of 60 days after application.
Wolverine Advanced	wheat, barley	all	Barley: 25 days for grazing or forage; 57 days for grain or straw Wheat: 25 days for grazing or forage; 70 days for grain or straw	

<sup>a</sup>Labels may have changed after this table was prepared. Consult current labels to verify the information.

<sup>b</sup>These are the restrictions on the Roundup labels and several other glyphosate products. Differences exist on some brands of glyphosate. Verify what restrictions apply to your brand before using it.

# Small grains insect management

Insecticides suggested in this section are intended as a guide to assist you in selecting chemical insect control options during the season. This book provides an overview of product registrations for specific field crop insect pests; it is not intended as an exhaustive insecticide label source. Product inclusion or omission does not imply endorsement by University of Wisconsin-Extension. Remember, certain insecticides are produced by different manufacturers and directions for use, rate, and method of application may vary by formulation. Therefore, always read the insecticide label completely before using the material.

Insecticides are often interchangeably referred to by their common names and trade names. Trade names such as Warrior II are capitalized, while common chemical names—lambda-cyhalothrin in this example—are not.

A number of the products listed in this section are restricted-use insecticides. We discuss restricted-use pesticides in the beginning of this publication. Refer to appendix table 7-2 for a list of insecticides that currently require certification to be applied. It is possible that additional insecticides will be classified before the next growing season. Contact your county Extension agent for additional information on insecticide restriction.

## Insect pests of small grains

### Aphids

Aphids (primarily greenbug, bird cherry-oat, corn leaf, and English grain aphid) damage plants indirectly by transmitting barley yellow dwarf virus (BYDV) and directly by sucking the sap. Light or heavy infestations of these small (less than 1/8 inch), green, soft-bodied insects may result in severe red-leaf damage of oats, but only heavy infestations cause yellowing and eventual browning. Once the red-leaf damage or yellowing is noticeable, it is usually too late to spray.

These aphids can also infect winter wheat in the fall. Winged, virus-infected aphids fly to the fields and then transmit the virus to the seedlings as they feed on them. The extent of BYDV infection of Wisconsin's winter wheat is related to the number of aphids present during the summer, the percent of the aphid population that carry the virus, and planting date of wheat. The degree of infection and subsequent winterkill, and yield reduction can be very high in fields planted during August if the numbers of infected aphids are high. Delaying planting until September 15<sup>th</sup> will avoid peak fall aphid flights.

Aphids injure small grains by sucking plant sap from leaves, stems, and/or heads and can cause direct yield loss under heavy infestations. When scout-

ing for aphids in winter wheat, take several counts throughout the field prior to heading. Examine 20 stems in each of five areas of the field (100 stems per field). For aphid treatment guidelines in winter wheat and small grains, refer to table 5-3.

Several insecticide seed treatments are labeled for early-season control of aphids (including bird cherry-oat, English grain, greenbug, and Russian wheat aphids) and to reduce the potential spread of BYDV. Read labels carefully to make sure they are labeled for your specific crop and to follow grazing restrictions. Treated seed may be obtained from seed dealers and/or seed treatment service providers.

### Armyworms

Armyworms can severely damage small grain fields. In mid-June and early July, these worms strip leaves and frequently clip off heads as the crop approaches maturity. By day, they hide on the soil surface and beneath clods. Detecting young larvae requires careful searching.

To guard against severe losses, check several areas of each field carefully. Check thick lodged areas first because armyworms will often be most numerous there. If you do not find worms in these areas, the odds are good that there are no problems in the rest of the field. However, check the field again in several days. If you find armyworms in the lodged areas, check several areas in the rest of the field. Treatment is suggested if populations average three or more per square foot. Before spraying, check the preharvest interval to make sure the selected insecticide fits with timing of harvest

**Table 5-3.** Treatment thresholds for aphids to prevent direct plant damage (not disease reduction) and subsequent grain yield loss

Growth stage	English grain aphid, corn leaf aphid, or oat-bird cherry aphid	Greenbug aphid
Seedling	30 aphids/stem	20 aphids/stem
Boot to heading	50 aphids/stem	30 aphids/stem

## Grasshoppers

Occasionally, grasshoppers are abundant enough to concern farmers. Insecticide use is not suggested until populations reach 20 per square yard in field margins or 8 per square yard in small grain fields. Apply treatments while grasshoppers are still small.

## Wireworms

Wireworms are small (less than 1-½ inches long), copper-colored larvae that attack underground stems and kill plants in irregular areas in oat fields. They are a problem mainly on the loamy soils of central Wisconsin.

Insecticide seed treatments are labeled for early-season suppression and/or control of wireworm in small grains. Consult labels for feeding and grazing restrictions. Treated seed may be obtained from seed dealers and/or seed treatment service providers.

## Insecticide suggestions for small grain pests

All insecticides listed in this section are to be applied to the plant foliage. Do not allow sprays to drift into beeyards or onto adjacent blooming crops or weeds.

### Aphids

#### Thresholds:

##### Seedling

30 aphids/stem (English grain aphid or oat-bird cherry aphid);  
20 aphids/stem (greenbug).

##### Boot to heading

50 aphids/stem (English grain aphid or oat-bird cherry oat aphid); 30 aphids/stem (greenbug).

### Besiege

**Rate:** 6.0-10.0 fl oz

**Active ingredient:** lambda-cyhalothrin, chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 30

**Maximum rate:** Do not apply more than 18.0 fl oz of Besiege or 0.06 lb ai of lambda-cyhalothrin-containing products or 0.2 lb ai of chlorantraniliprole-containing products/a/year.

### Cruiser 5FS

**Active ingredient:** thiamethoxam

**IRAC code:** 4A

**Comment:** For early-season control of aphids and to reduce the potential spread of barley yellow dwarf virus. At the high rate, reduces grasshoppers during the early season.

**Note:** For use in commercial seed treaters only or certified retail treatment locations. Packaged with compatible and registered fungicide seed treatments.

### Cruiser Maxx Cereals

**Active ingredient:** thiamethoxam

**IRAC code:** 4A

**Comment:** For protection against aphids, an additional amount of Cruiser 5FS must be mixed with Cruiser Maxx Cereals. See Label for directions.

**Note:** For use in commercial seed treaters only or certified retail treatment locations. Packaged with compatible and registered fungicide seed treatments.

## Declare

**Rate:** 1.02-1.54 fl oz

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 30

**Maximum rate:** 0.03 lb ai (0.19 pt)/a/season

**Comment:** Best control obtained before aphids begin to roll leaves. Once wheat has started to boot, may provide suppression only. Higher rates and coverage will be necessary.

*Precautions: Do not allow livestock to graze treated areas or harvest treated wheat forage as feed for meat or dairy animals within 7 days after last treatment. Do not feed treated straw to meat or dairy animals within 30 days after the last treatment.*

## Dimethoate

**Rate:** See label (rate varies by formulation)

**Active ingredient:** dimethoate

**IRAC code:** 1B

**Preharvest interval (days):** Consult label

**Maximum rate:** May vary by label

*Precautions: Consult label*

## Fastac EC

**Rate:** 3.2-3.9 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 14

**Maximum rate:** 11.4 fl oz (0.075 lb ai)/a/season

**Comment:** Control may be variable depending on species present and host-plant relationships.

**Note:** Registered for wheat and triticale

## Fastac SC

**Rate:** 3.2-3.9 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 14

**Maximum rate:** 11.4 fl oz (0.075 lb ai)/a/season

**Comment:** Control may be variable depending on species present and host-plant relationships.

**Note:** Registered for wheat and triticale

## Gaucho 600

**Active ingredient:** imidacloprid

**IRAC code:** 4A

**Comment:** For early season protection of seedlings against injury by aphids.

*Precautions: Do not graze or feed livestock on treated areas for 45 days after planting.*

## Mustang Maxx

**Rate:** 3.2-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 14 days for grain, forage, and hay

**Maximum rate:** 20 fl oz (0.125 lb ai)/a/season

**Comment:** Aphid control may be variable depending on species present and host-plant relationships.

## Silencer

**Rate:** 2.56-3.84, Varies by aphid species

**Active Ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 days.

**Maximum rate:** Do not apply more than 0.06 lb ai (0.48 pt)/a/season

**Comment:** For suppression of corn leaf aphid.

*Precaution: Do not allow livestock to graze in treated areas or harvested treated wheat forage as feed for meat or dairy animals within 7 days. Do not feed treated straw to meat or dairy animals within 30 days after last treatment.*

## Transform WG

**Rate:** 0.75-1.0 oz

**Active ingredient:** sulfoxaflo

**IRAC code:** 4C

**Preharvest interval (days):** 14 days for grain or straw. 7 for grazing, forage, fodder or hay harvest

**Maximum rate:** Do not apply more than a total of 2.8 oz per acre per year

## Warrior II

**Rate:** 1.28-1.92, Varies by aphid species

**Active Ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 days for grain.

**Maximum rate:** 0.06 lb ai (3.84 fl oz or 0.24 pt)/a/season

**Comment:** Best control obtained before aphids begin to roll leaves. Once wheat has started to boot, may provide suppression only. Higher rates and coverage will be necessary.

*Precaution: Do not allow livestock to graze in treated areas or harvest treated wheat forage as feed for meat or dairy animals within 7 days of treatment.*

## Grasshopper

**Threshold:** 20 adults and nymphs per sq yd in field margins or 8 per sq yd in small grain fields.

## Besiege

**Rate:** 6.0-10.0 fl oz

**Active ingredient:** lambda-cyhalothrin, chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 30

**Maximum rate:** Do not apply more than 18.0 fl oz of Besiege or 0.06 lb ai of lambda-cyhalothrin-containing products or 0.2 lb ai of chlorantraniliprole-containing products/a/year.

## Declare

**Rate:** 1.02-1.54 fl oz

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 30

**Maximum rate:** 0.03 lb ai (0.19 pt)/a/season

*Precautions: Do not allow livestock to graze treated areas or harvest treated wheat forage as feed for meat or dairy animals within 7 days after last treatment. Do not feed treated straw to meat or dairy animals within 30 days after the last treatment.*

## Dimethoate

**Rate:** See label (rate varies by formulation)

**Active ingredient:** dimethoate

**IRAC code:** 1B

**Preharvest interval (days):** Consult label

**Maximum rate:** May vary by label

*Precautions: Consult label*

## Fastac EC

**Rate:** 3.2-3.9 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 14

**Maximum rate:** 11.4 fl oz (0.075 lb ai)/a/season

**Note:** Registered for wheat and triticale

## Fastac SC

**Rate:** 3.2-3.9 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 14

**Maximum rate:** 11.4 fl oz (0.075 lb ai)/a/season

**Note:** Registered for wheat and triticale

## Mustang Maxx

**Rate:** 3.2-4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 14 days for grain, forage, and hay

**Maximum rate:** 20 fl oz (0.125 lb ai)/a/season

## Silencer

**Rate:** 2.56-3.84,

**Active Ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 days.

**Maximum rate:** Do not apply more than 0.06 lb ai (0.48 pt)/a/season

*Precaution: Do not allow livestock to graze in treated areas or harvested treated wheat forage as feed for meat or dairy animals within 7 days. Do not feed treated straw to meat or dairy animals within 30 days after last treatment.*

## Vantacor

**Rate:** 0.7-1.7 fl oz

**Active ingredient:** chlorantraniliprole

**IRAC code:** 28

**Preharvest interval (days):** 1

**Maximum rate:** Do not apply more than 5.1 fl oz of Vantacor or 0.2 lb ai of chlorantraniliprole-containing products/a/year.

## Warrior II

**Rate:** 1.28-1.92,

**Active Ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 days for grain.

**Maximum rate:** 0.06 lb ai (3.84 fl oz or 0.24 pt)/a/season

*Precaution: Do not allow livestock to graze in treated areas or harvest treated wheat forage as feed for meat or dairy animals within 7 days of treatment.*

## Armyworm

**Threshold:** 3 larvae/sq ft

## Baythroid XL

**Rate:** 1.8-2.4 fl oz (first and second instars)

**Active ingredient:** cyfluthrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 days for grain.

**Pre-grazing or foraging interval:** 3 days.

**Maximum rate:** 4.8 fl oz (0.038 lb ai)/a/season

**Comment:** Apply to first and second instars.

## Besiege

**Rate:** 6.0-10.0 fl oz

**Active ingredient:** lambda-cyhalothrin, chlorantraniliprole

**IRAC code:** 3A, 28

**Preharvest interval (days):** 30

**Maximum rate:** Do not apply more than 18.0 fl oz of Besiege or 0.06 lb ai of lambda-cyhalothrin-containing products or 0.2 lb ai of chlorantraniliprole-containing products/a/year.

## Declare

**Rate:** 1.02-1.54 fl oz

**Active ingredient:** gamma-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 30

**Maximum rate:** 0.03 lb ai (0.19 pt)/a/season

*Precaution: Do not allow livestock to graze treated areas or harvest treated wheat forage as feed for meat or dairy animals within 7 days after last treatment. Do not feed treated straw to meat or dairy animals within 30 days after the last treatment.*

---

### Fastac EC

**Rate:** 1.8–3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 14

**Maximum rate:** 11.4 fl oz (0.075 lb ai)/a/season

**Comment:** Registered for wheat and triticale.

---

### Fastac SC

**Rate:** 1.8–3.8 fl oz

**Active ingredient:** alpha-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 14

**Maximum rate:** 11.4 fl oz (0.075 lb ai)/a/season

**Comment:** Registered for wheat and triticale.

---

### Mustang Maxx

**Rate:** 1.76–4.0 fl oz

**Active ingredient:** zeta-cypermethrin

**IRAC code:** 3A

**Preharvest interval (days):** 14 days for grain, forage, and hay

**Maximum rate:** 20 fl oz (0.125 lb ai)/a/season

---

### Silencer

**Rate:** 2.56–3.84 fl oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 30

**Maximum rate:** Do not apply more than 0.06 lb ai (0.48 pt)/a/season.

*Precaution: Do not allow livestock to graze in treated areas or harvested treated wheat forage as feed for meat or dairy animals within 7 days. Do not feed treated straw to meat or dairy animals within 30 days after last treatment.*

---

### Tracer

**Rate:** 1.5–3.0 fl oz

**Active ingredient:** spinosad

**IRAC code:** 5

**Preharvest interval (days):** 21 days for grain or straw; 3 days for forage, fodder, or hay

**Maximum rate:** 9 fl oz (0.28 lb ai)/a/season

*Precautions: Do not allow cattle to graze treated area until spray has dried.*

---

### Vantacor

**Rate:** 1.2–2.5 fl oz

**Active ingredient:** chlorantraniliprole

**IRAC code:** 28

**Preharvest interval (days):** 1

**Maximum rate:** Do not apply more than 5.1 fl oz of Vantacor or 0.2 lb ai of chlorantraniliprole-containing products/a/year.

---

### Warrior II

**Rate:** 1.28–1.92 oz

**Active ingredient:** lambda-cyhalothrin

**IRAC code:** 3A

**Preharvest interval (days):** 30 days for grain.

**Maximum rate:** 0.06 lb ai (3.84 fl oz or 0.24 pt)/a/season

*Precaution: Do not allow livestock to graze in treated areas or harvest treated wheat forage as feed for meat or dairy animals within 7 days of treatment.*

# Small grains disease management

Many disease-causing organisms attack small grains in Wisconsin. Any approach to plant disease control requires identification and knowledge of the cause and its life cycle, the effect of environment on disease development, and the potential control measures available. Economic and environmental factors often determine the control procedures employed for these various diseases. Control strategies can be an integration of the following methods: planting resistant or tolerant varieties, proper crop management, and agricultural chemicals (mostly fungicides).

Variety selection is key to disease management in small grains. Refer to Extension publications *Wisconsin Oats and Barley Performance Tests* and *Wisconsin Winter Wheat Performance Tests* (A3868) at <https://coolbean.info/small-grains/variety-trial-results/> for specific disease-resistance ratings. These publications are updated each year with new test data for each variety.

## Small grain diseases

### Barley yellow dwarf (red leaf)

Wheat Barley yellow dwarf or barley and oat red leaf are caused by the same virus—barley yellow dwarf virus (BYDV). Infected wheat or barley plants show yellowed foliage, stunted plants, and underdeveloped heads. Infected oat plants also are stunted and have underdeveloped heads, but the foliage becomes red with slight yellowing—thus, the common name red leaf.

Aphids transmit the barley yellow dwarf virus. The virus overwinters in wild grasses and winter wheat; however, inoculum carried in from southern states by aphids appears to be more critical in disease development. Volunteer oat and virus-car-

rying aphids serve as inoculum for infection of winter wheat in the fall. Corn is another source of inoculum of BYDV.

To control red leaf, choose resistant varieties of oat. Most wheat varieties are susceptible. Plant oat, barley, and spring wheat early to avoid high populations of virus-laden aphids. Delay planting of winter wheat to avoid high aphid populations in the fall. Generally, winter wheat planted after mid-September is less affected by BYDV. Encourage good vegetative growth by seeding at appropriate rates and by using fertility management techniques.

### Ergot

Ergot is an important disease in rye, triticale, wheat, and barley, but it is rare in oats. Some of the grain in an infected head is replaced with a long, purple-black, horn-like fungus structure that may reach 1 inch in length. Ergot causes little or no yield loss, but it is toxic if fed to livestock. All varieties of rye are susceptible. Information is not available on barley and wheat varieties.

### Leaf, stripe, and stem rust

Leaf, stripe, and stem rust occur on all small grains grown in Wisconsin. Disease severity differs each year depending on weather conditions, varieties of small grains grown, and prevalent strain(s) of the rust fungi present. Small grain yields can be greatly reduced as a result of severe rust development, especially if infection happens prior to head emergence.

There are several possible ways to control or reduce rust in small grains. In most years, early planting effectively controls stem rust of oat, and stem rust and leaf rust of spring wheat. Stem rust

fungi do not overwinter in Wisconsin, and inoculum must be introduced from states south of Wisconsin. The wheat leaf rust fungus can overwinter on winter wheat if the crop does not freeze, although this situation rarely occurs.

Oat leaf rust (crown rust) survives on buckthorn bushes, which serve as a source of inoculum each spring. Thus, early planting has less of an impact on leaf rust development on oat. Destruction of buckthorn bushes in the vicinity of oat fields can suppress oat leaf rust.

Rust diseases of small grains can be controlled effectively by planting rust-resistant varieties. However, new races of the rust fungi frequently develop and infect varieties that were formerly resistant. Beware of rust development in varieties rated as resistant.

Foliar-applied fungicides are registered for rust control in small grains (table 5-4). See product label for registered crops, rates, and timing of applications.

### Powdery mildew

Powdery mildew is caused by the fungus *Blumeria graminis*. White to light gray, powdery patches form on the leaves, sheaths, stems, and floral bracts. Black specks (cleistothecia) form in the powdery growth as the crop matures. When mildew growth is severe, infected leaves wither and die early. The fungus overwinters on living and dead plants.

Choose resistant varieties of small grains to control powdery mildew. If the disease is present on lower leaves and the plants are reaching the boot stage, consider the application of foliar fungicides.

## Scab

In its most conspicuous form, scab in wheat and barley is a head blight, recognized by the premature ripening or bleaching of one or more spikelets of a grain head any time after heading. The light yellow color of diseased regions of a head show in sharp contrast with the healthy green of the remaining portion of the head. A light pink or salmon color may appear at the base of infected spikelets. Infected kernels are a white, salmon, or reddish color, are badly shrunk and wrinkled, and have a noticeably rough, flaky seed coat. Sometimes the scab fungus girdles the stem below the head, not allowing the head to develop. Stem tissues immediately below the head will turn brown. Scab reduces yield and quality of wheat and barley.

The scab fungus produces mycotoxins that are harmful if scabby grain is fed to swine. In swine, avoid feeding wheat (or barley) with more than 10% scabby kernels, as this may cause vomiting, feed refusal, and reproductive problems since there is an increased risk for mycotoxins in these samples.

If seed from scabby fields is planted, seed rot, seedling blight, crown rot, and root rot can cause loss of stand and subsequent yield loss. The most common scab fungus, *Fusarium graminearum*, is the same organism that can cause root rot, stalk rot, and ear rot of corn. Thus, wheat or barley that is planted after corn generally has a higher incidence and severity of scab. If wheat or barley must follow corn, deep incorporation of corn debris should reduce the potential for scab development.

## Septoria black stem of oat

Septoria black stem of oat appears as oval, chocolate-brown spots on leaf blades and sheaths. Small, black fruiting bodies of the fungus appear in the center of the spots. Stems under sheath spots are dark brown to black and are rotted. The rotted stems are weakened, and severely infected

plants will lodge and make harvesting difficult. Infected kernels are purple to black. Oat varieties differ in susceptibility.

## Septoria leaf blotch of wheat

Septoria leaf blotch is caused by the fungus *Septoria tritici*. Small, light green to yellow spots on the leaves and sheaths enlarge and merge to form irregular, tan to reddish brown blotches with gray-brown to ash-colored centers often partly surrounded by a yellow margin. Septoria leaf blotch can be found with another disease caused by the fungus *Stagonospora nodorum* and therefore, may be defined as a complex of the two diseases. Black specks (pycnidia) form in older lesions or at stem nodes. Affected leaves often turn yellow, wither, and die early. The fungus survives in living and dead wheat plants and in seed.

Rotate crops to control Septoria leaf blotch. If planting wheat in fields that were cropped to wheat the previous year, deep incorporation of wheat residue offers some control. Wheat varieties differ in resistance to Septoria leaf blotch. However, available levels of resistance will not provide adequate control during moderate to severe epidemics. Foliar-applied fungicides are necessary if weather and management practices create an environment favorable for severe Septoria leaf blotch development. Apply foliar fungicides at the emergence of the flag leaf into the boot stage to protect the flag leaf of plants.

## Smut

Smut in small grains has greatly increased in recent years and has been particularly severe in oat. Plants infected with a smut fungus appear normal until the heads emerge. The grain in infected plants is replaced by the smut fungus and appears as a black powdery mass of spores. The smut fungi are carried with the seed and do not survive in the soil or plant debris. Planting seed from fields with smutted plants the previous year

will perpetuate the problem. Do not confuse weathered blackened heads with smut. The heads of small grains are often colonized by non-pathogenic fungi that make the heads black. However, in contrast to smut that replaces the grain with its sooty black spores, the grain is present in the weathered heads. Although similar in appearance and biology, smut diseases of small grains are caused by different fungi. These include loose smut of wheat, loose smut of barley, loose smut of oat, covered smut of oat, covered smut of barley and bunt, or stinking smut of wheat.

To control smut diseases of small grains, do not plant seeds from fields heavily infested with smut. You can use seed from fields with less than 1% smutted heads without a significant risk of smut development. Small grain seed certified by the Wisconsin Crop Improvement Association ([wcia.wisc.edu](http://wcia.wisc.edu)) has been grown using procedures that control smut diseases. Plant resistant varieties. Many races of smut fungi of oat are present in Wisconsin and more races may develop that attack oat varieties that are currently resistant.

Certain fungicide seed treatments effectively control smut diseases of small grains (table 5-5). Mechanical seed treatment is recommended but not necessary. Follow the directions on the product label to assure proper treatment, handling, and use of seed treated with fungicide. Fungicide-treated seed cannot be used for food, feed, or oil.

## Take-all

Take-all is a root rot disease caused by a soil-inhabiting fungus. Winter wheat is most affected. Spring wheat, barley, and oat are the least susceptible. Symptoms of take-all include stunted plants and bleached-white heads. Lower stems show a black, rotted appearance, and the plants present a rotted and sparse root system.

To reduce the incidence and severity of take-all, rotate crops and control wild grasses such as quackgrass.

Make sure levels of soil nitrogen are adequate. The  $\text{NH}_3$  form of nitrogen suppresses take-all. Consider using nitrapyrin (N-Serve), a nitrogen stabilizer; it improves the effectiveness of nitrogen fertilization. Delay winter wheat planting to escape fall

infection. Winter wheat planted after alfalfa may be at risk because of invasion by quackgrass. Take-all is seldom a problem in a rotation sequence of soybean-winter wheat.

**Table 5-4.** Fungicides for control of foliar diseases of small grains

Fungicide	Fusarium head scab	Stripe rust	Leaf rust	Stem rust	Powdery mildew	Septoria leaf blotch	Glume blotch	Tan spot	Active ingredient(s)	Chemical family (FRAC code <sup>a</sup> )	Amount/use/a	Preharvest interval (PHI)
Absolute Maxx SC Absolute 500 SC	-	8	10	8	6	8	8	8	tebuconazole +trifloxystrobin	triazole (3) +Qol (11)	crop-dependent	<b>Wheat:</b> 35 days for grain <b>Barley:</b> 40 days for grain
<b>Remarks:</b> For use on barley and wheat only. For wheat do not apply more than 5 fl oz/a/season. Do not apply within 30 days of harvest for grazing and hay or 45 days for wheat straw. For barley do not apply more than 3.3 fl oz/a/season. Do not allow livestock to graze or harvest within 30 days for hay. Do not harvest within 45 days for hay.												
Adastrio	-	x	x	x	x	x	x	x	Azoxystrobin +fluindapyr + flutriafol	Qol inhibitor (11) +carboximides (7) + triazole (3)	5-9 fl oz	<b>Forage:</b> 7 days <b>Hay:</b> 15 days <b>Grain/straw:</b> 30 days
<b>Remarks:</b> For use on wheat (spring and winter), triticale, and barley. Do not make more than two (2) sequential applications. Do not apply more than 18 fl oz per acre per year.												
AfterShock	-	x	8	x	6	x	x	8	fluoxastrobin	Qol (11)	2-4 fl oz	7 days
<b>Remarks:</b> Apply to wheat only. Do not apply more than 22.8 fl oz/a/year or more than six applications/season.												
AmTide Propiconazole	2	8	8	8	8	8	8	8	propiconazole	triazole (3)	2-4 fl oz	40 days for grain and straw, 30 days for forage, 45 days for hay
<b>Remarks:</b> Do not apply more than 8 fl oz/a per season or more than 4 fl oz/a/season when forage or hay is harvested.												
Approach	-	10	8	8	8	8	8	8	picoxystrobin	Qol (11)	3-12 fl oz	45 days for grain, 7 days for forage, 14 days for hay
<b>Remarks:</b> No more than two sequential applications before switching to a fungicide with a different mode of action. For grain do not apply later than the beginning of flowering (Feekes 10.5). Do not exceed 36 fl oz/a/crop.												
Approach Prima	x	10	8	x	8	8	8	8	picoxystrobin +cyproconazole	Qol (11) +triazole (3)	3.4-6.8 fl oz	45 days; 21 days for forage or hay
<b>Remarks:</b> Do not apply more than 6.8 fl oz/a/year. Do not apply more than two sequential applications of fungicide products containing a Qol (11) component.												

Efficacy ratings: Excellent = 10; very good = 8; good = 6; fair = 4; poor = 2; no control = 0; labeled, no data = x; not labeled = -

<sup>a</sup> Fungicide group numbers indicate the modes of action: multiple applications of fungicides with same group number increases the chances for resistance.

Continued on next page

**Table 5-4.** Fungicides for control of foliar diseases of small grains (continued)

Fungicide	Fusarium head scab	Stripe rust	Leaf rust	Stem rust	Powdery mildew	Septoria leaf blotch	Glume blotch	Tan spot	Active ingredient(s)	Chemical family (FRAC code <sup>a</sup> )	Amount/use/a	Preharvest interval (PHI)
Avaris	-	10	10	8	8	8	8	8	azoxystrobin +propiconazole	Qol (11) +triazole (3)	7-14 fl oz	<b>Barley, triticale:</b> Do not apply within 45 days for grain harvest or 30 days for forage and hay. <b>Wheat:</b> Do not apply after Feekes 10.5
<b>Remarks:</b> Do not apply more than two applications/season. Do not apply more than 28 fl oz/a/season. Do not apply more than 0.22 lb ai/a propiconazole-containing products/season. Do not apply more than 0.40ai/a azoxystrobin-containing products/season.												
Bumper 41.8 EC	2	8	8	8	8	8	8	8	propiconazole	triazole (3)	2-4 fl oz	<b>Barley, oat, rye, triticale:</b> 30 days for forage or hay, 45 days for grain and straw <b>Wheat:</b> Do not apply after Feekes 10.5 growth stage
<b>Remarks:</b> For use on barley, oat, rye, triticale, and wheat. Consult the label for disease- and crop-specific recommendations and rates.												
Caramba	6	10	10	10	8	x	8	8	metconazole	triazole (3)	10-14 fl oz (13.5-17 fl oz for head scab suppression only)	30 days
<b>Remarks:</b> For use on barley, oat, rye, triticale, and wheat. Make no more than two applications per season at a maximum product rate of 34 fl oz/a/season.												
Cuprofix Ultra 40 Disperss	-	-	-	-	-	x	-	x	basic copper sulfate	inorganic (M1)	1-1.25 lb	Not listed.
<b>Remarks:</b> For use on barley, oat, and wheat.												
Custodia	x	x	x	x	x	x	x	x	azoxystrobin +tebuconazole	Qol (11) +triazole (3)	6.4-8.6 fl oz	45 days for grain; 14 days for forage and hay
<b>Remarks:</b> Do not apply more than one application/a/year. Do not apply more than 0.40 lb ai azoxystrobin-containing products/year. Do not apply to wheat after Feekes 10.5 growth stage.												
Delaro Complete	-	x	x	x	x	x	x	x	prothioconazole +trifloxystrobin +fluopyram	triazole (3) +Qol (11) +carboximides (7)	8.0 fl oz	35 days
<b>Remarks:</b> Do not apply more than 16.0 fl oz of Delaro complete per season. Do not make more than 2 applications of Delaro Complete per season. Do not graze with in 30 days of application or use hay within 45 days of application. Grazing and use for forage is allowed if only 8.0 fl oz of Delaro Complete is used per season. If higher rates of Delaro Complete are used, grazing and feeding of hay is not allowed.												
Dithane F-45	-	x	x	x	-	x	x	x	mancozeb	dithiocarbamate (M3)	1.2 qt	Do not apply after Feekes growth stage 10.5 or within 26 days of harvest
Rainshield	-	x	x	x	-	x	x	x			2.0 lb	
Dithane M-45	-	x	x	x	-	x	x	x				
<b>Remarks:</b> For use on barley, oat, rye, triticale, and wheat. Refer to label for crop-specific information. Do not make more than three applications during the season. Do not graze livestock in treated areas prior to harvest.												

Efficacy ratings: Excellent = 10; very good = 8; good = 6; fair = 4; poor = 2; no control = 0; labeled, no data = x; not labeled = -

<sup>a</sup> Fungicide group numbers indicate the modes of action: multiple applications of fungicides with same group number increases the chances for resistance.

Continued on next page

**Table 5-4.** Fungicides for control of foliar diseases of small grains (continued)

Fungicide	Fusarium head scab	Stripe rust	Leaf rust	Stem rust	Powdery mildew	Septoria leaf blotch	Glume blotch	Tan spot	Active ingredient(s)	Chemical family (FRAC code <sup>a</sup> )	Amount/use/a	Preharvest interval (PHI)
Equation	-	10	10	10	6	8	8	10	azoxystrobin	Qol (11)	4.0-12.0 fl oz	<b>Barley, triticale:</b> 45 days for grain, 30 days for forage or hay <b>Wheat:</b> Do not apply later than Feekes growth stage 10.5
<b>Remarks:</b> For use on barley, triticale, and wheat. Do not apply more than 0.40 lb. ai/a/season of azoxystrobin-containing products. Do not apply more than two sequential applications of Quadris or other group-11 fungicides before alternating with a fungicide that is not in Group 11.												
Evito 480 SC	-	x	8	x	4	x	x	8	fluoxasbrobin	Qol (11)		Do not apply after Feekes 10.5
<b>Remarks:</b> Use on wheat only. Do not apply more than 8 fl oz/a/year. The maximum is two applications per season.												
Evito T	-	x	x	x	-	x	x	x	fluoxastrobilin + tebuconazole	Qol (11) + triazole (3)	4-6 fl oz	40 days for grain or straw; 7 days for forage or hay
<b>Remarks:</b> Do not apply more than 12 fl oz per acre per year. Do not apply more than two applications per season.												
Folicur 3.6F	4	10	10	10	-	-	-	-	tebuconazole	triazole (3)	4 fl oz	Do not apply within 30 days of harvest
<b>Remarks:</b> For use on barley and wheat. A maximum of 4 fl oz may be applied/a/season.												
Fortix	-	x	x	x	x	x	x	x	fluoxastrobilin + flutriafol	Qol (11) + triazole (3)	2-6 fl oz	40 days for grain; 15 days for hay; 7 days for forage
<b>Remarks:</b> for early season suppression of diseases apply 2-3 fl oz of Fortix. To protect the flag leaf, apply when 50% or all of the flag leaf is emerged and use 4-6 fl oz per acre. Do not apply more than 12 fl oz per acre per year.												
Headline Headline SC	-	10	10	6	6	8	8	10	pyraclostrobin	Qol inhibitor (11)	6-9 fl oz	<b>Barley, rye:</b> Apply no later than 50% head emergence (Feekes 10.3; Zadoks 55) <b>Oat, wheat, triticale:</b> Apply no later than the beginning of flowering (Feekes 10.5; Zadoks 55)
<b>Remarks:</b> For use on barley, oat, rye, triticale, and wheat. Do not make more than two sequential foliar applications. Do not apply more than 18 fl oz/a/season.												
Kocide 2000 Kocide 3000	x	x	x	x	x	x	x	-	copper hydroxide	inorganic (M1)	1.0-1.5 lb 0.50-0.75 lb	0 days
<b>Remarks:</b> For use on barley, oat, and wheat. Maximum rate is 3.5 lb/a/season.												
Koverall	-	x	x	x	-	x	x	x	mancozeb	dithiocarbamate (M3)	2.0 lb	26 days
<b>Remarks:</b> For use on wheat, barley, oat, and triticale. Do not apply more than 6.0 lb/a/season. Do not graze livestock on treated area prior to harvest.												

Efficacy ratings: Excellent = 10; very good = 8; good = 6; fair = 4; poor = 2; no control = 0; labeled, no data = x; not labeled = -

<sup>a</sup> Fungicide group numbers indicate the modes of action: multiple applications of fungicides with same group number increases the chances for resistance.

Continued on next page

**Table 5-4.** Fungicides for control of foliar diseases of small grains (continued)

Fungicide	Fusarium head scab	Stripe rust	Leaf rust	Stem rust	Powdery mildew	Septoria leaf blotch	Glume blotch	Tan spot	Active ingredient(s)	Chemical family (FRAC code <sup>a</sup> )	Amount/use/a	Preharvest interval (PHI)
Manzate ProStick Manzate Flowable	-	x	x	x	-	x	x	x	mancozeb	dithiocarbamate (M3)	2.0 lb 1.6 qt	26 days
<b>Remarks:</b> For use on barley, oat, rye, triticale, and wheat. NO more than three applications per season. Do not apply more than 6 lb Manzate ProStick or 4.8 qt Manzate Flowable/a/crop. Do not graze livestock in treated areas prior to harvest.												
Miravis Ace	6	8	8	8	8	8	8	8	pydiflumetofen +propiconazole	carboximides (7) +triazole (3)	13.7 fl oz	Do not apply after Feekes 10.5.4 or 7 days before harvesting for forage.
<b>Remarks:</b> Apply between Feekes 10.3 and 10.5.2 for optimum Fusarium head blight management. Do not apply more than 13.7 fl oz per year if using for forage or hay.												
Muscle 3.6 F Orius 3.6 F	4	10	10	10	-	-	-	-	tebuconazole	triazole (3)	4 fl oz	30 days
<b>Remarks:</b> For wheat and barley only. A maximum rate of 4 fl oz/a/season may be applied.												
Nexicor	-	10	10	8	8	10	8	10	propiconazole +pluxopyroxad +pyraclostrobin	triazole (3) +carboximides (7) +QoI inhibitor (11)	7.0 – 13.0 fl oz	7 days
<b>Remarks:</b> Do not apply more than 13 fl oz per acre per year where forage is to be harvested. The absolute maximum rate per acre per year is 26 fl oz.												
Oxidate 2.0	-	-	-	-	x	-	-	-	hydrogen dioxide +peroxyacetic acid	unknown (u)	1:400 – 1:40 dilution	0 days
<b>Remarks:</b> Do not apply high rate to blooming crops. Test for phytotoxicity at the high rate. Frequent and repeated applications may be needed when conditions are conducive for disease.												
Penncozeb 75 DF Penncozeb 80 WP	-	x	x	x	-	x	x	x	mancozeb	dithiocarbamate (M3)	1.0–2.0 lb 1.0–2.0 lb	Do not apply after heading or Feekes 10.5 but not less than 26 days before harvest
<b>Remarks:</b> For use on barley, oat, rye, triticale, and wheat. NO more than three applications per season. Read label for total amount of product to apply per acre per season.												
Priaxor	-	8	8	6	6	8	8	10	fluxapyroxad +pyraclostrobin	carboximide (7) +QoI (11)	4-8 fl oz	<b>Barley, oat:</b> Apply no later than 50% head emergence (Feekes 10.3; Zadoks 55) <b>Rye, triticale, wheat:</b> Apply no later than beginning of flowering (Feekes 10.5; Zadoks 59)
<b>Remarks:</b> No more than two applications per season or two consecutive applications before alternating to a labeled fungicide with a different mode of action. Do not apply more than 16 fl oz/a/season.												
Proline 480 SC	6	8	8	8	x	8	8	8	prothioconazole	triazole (3)	2.8-5.7 fl oz	<b>Barley:</b> 32 days <b>Oat, rye, triticale, wheat:</b> 30 days
<b>Remarks:</b> For use on barley, oat, rye, triticale, and wheat. Consult the label for crop and disease specific recommendations and rates.												

Efficacy ratings: Excellent = 10; very good = 8; good = 6; fair = 4; poor = 2; no control = 0; labeled, no data = x; not labeled = -

<sup>a</sup> Fungicide group numbers indicate the modes of action: multiple applications of fungicides with same group number increases the chances for resistance.

Continued on next page

**Table 5-4.** Fungicides for control of foliar diseases of small grains (continued)

Fungicide	Fusarium head scab	Stripe rust	Leaf rust	Stem rust	Powdery mildew	Septoria leaf blotch	Glume blotch	Tan spot	Active ingredient(s)	Chemical family (FRAC code <sup>a</sup> )	Amount/use/a	Preharvest interval (PHI)
Propicure	2	8	8	8	8	8	8	8	propiconazole	triazole (3)	2-4 fl oz.	<b>Wheat, barley, rye, triticale, oat:</b> 40 days for grain, 30 days for forage, 45 days for hay
<b>Remarks:</b> Do not apply more than 8 fl oz/a/season. Do not apply more than 4 fl oz/a/season if forage or hay will be harvested.												
PropiMax EC	2	8	8	8	8	8	8	8	propiconazole	triazole (3)	2-4 fl oz.	<b>Wheat:</b> Do not apply after Feekes 10.5 <b>Barley, oat, rye, triticale:</b> 30 days for forage or hay, 45 days for grain and straw
<b>Remarks:</b> For use on barley, oat, rye, triticale, and wheat. Do not apply more than 8 fl oz/a/season. Do not apply more than 4 fl oz/a/season if forage or hay will be harvested.												
Prosaro 421 SC	6	10	10	10	6	8	8	8	prothioconazole +tebuconazole	triazole (3) triazole (3)	6.5-8.2 fl oz	30 days
<b>Remarks:</b> For use on barley and wheat. A maximum of 8.2 fl oz/a/crop/year may be applied. Straw may be fed or used for bedding. Grazing permitted 6 or more days after last application.												
Prosaro Pro	6	10	10	10	6	10	10	10	prothioconazole +tebuconazole +fluopyram	triazole (3) +triazole (3) +carboximides (7)	10.3-13.6 fl oz	30 days
<b>Remarks:</b> Do not apply more than 13.6 fl oz of Prosaro Pro per acre per year. Do not make more than 2 sequential applications of Group 7 products without switching products.												
Quadris	-	10	10	10	6	8	8	10	azoxystrobin	Qol inhibitor (11)	4.0-12.0 fl oz	7 days <b>Wheat, triticale:</b> 14 days if used for grazing.
<b>Remarks:</b> For use on barley, triticale, wheat, oat, and rye. Do not apply more than 0.40 lb. ai/a/season of azoxystrobin-containing products. Do not apply more than two sequential applications of Quadris or other Group-11 fungicides before alternating with a fungicide that is not in Group 11.												
Quilt	-	10	10	8	8	8	8	8	propiconazole +azoxystrobin	triazole (3) +Qol inhibitor (11)	7-14 fl oz	<b>Wheat:</b> Do not apply after Feekes growth stage 10.5 or within 7 days for forage or hay <b>Barley, triticale:</b> 45 days for grain, 30 days for forage or hay <b>Oat, rye:</b> 0 days
<b>Remarks:</b> For use on barley, triticale, wheat, oat, and rye. Do not apply more than two applications per acre per season. Do not apply more than 28.0 fl oz/a/season of Quilt. Do not apply more than 0.22 lb ai of propiconazole-containing products/a/season. Do not apply more than 0.40 lb. ai azoxystrobin-containing products/a/season.												

Efficacy ratings: Excellent = 10; very good = 8; good = 6; fair = 4; poor = 2; no control = 0; labeled, no data = x; not labeled = -

<sup>a</sup> Fungicide group numbers indicate the modes of action: multiple applications of fungicides with same group number increases the chances for resistance.

Continued on next page

**Table 5-4.** Fungicides for control of foliar diseases of small grains (continued)

Fungicide	Fusarium head scab	Stripe rust	Leaf rust	Stem rust	Powdery mildew	Septoria leaf blotch	Glume blotch	Tan spot	Active ingredient(s)	Chemical family (FRAC code <sup>a</sup> )	Amount/use/a	Preharvest interval (PHI)
Quilt Xcel	-	10	10	8	8	8	8	8	propiconazole + azoxystrobin	triazole (3) + Qol inhibitor (11)	7-14 fl oz	<b>Wheat:</b> Do not apply after Feekes growth stage 10.5 or within 7 days for forage or hay <b>Barley, triticale:</b> 45 days for grain, 30 days for forage or hay <b>Oat, rye:</b> 0 days
<b>Remarks:</b> For use on barley, triticale, wheat, oat, and rye. Applications can be made not closer than a 14-day interval. Do not apply more than two applications per acre per season. Do not apply more than 28.0 fl oz/a of Quilt Xcel or more than 0.22 lb ai of propiconazole-containing products/a/season. Do not apply more than 0.40 lb ai azoxystrobin-containing products/a/season. Under certain environmental conditions, tank mixes of Quilt Xcel plus herbicides and/or fertilizers may cause crop injury.												
Sphaerex	6	10	10	10	8	8	8	8	Metconazole + prothioconazole	triazole (3) + triazole (3)	4.0-7.3 fl oz	30 days
<b>Remarks:</b> If Sphaerex fungicide is applied with other emulsifiable concentrate (EC) pesticides, phytotoxicity can occur. Livestock may graze treated fields. Do not apply more than 7.3 fl oz of Sphaerex fungicide per application per acre. Do not apply more than 2 applications of Sphaerex or other group 3 fungicides per acre per year.												
Stratego	-	8	8	8	6	8	8	8	propiconazole + trifloxystrobin	triazole (3) + Qol inhibitor (11)	7-10 fl oz	<b>Barley, oat:</b> Do not apply after Feekes growth stage 8 or within 40 days of harvest <b>Wheat, triticale:</b> Do not apply after Feekes 10.5 growth stage or within 35 days of harvest
<b>Remarks:</b> For use in barley, oat, triticale, and wheat. Consult label for crop- and disease-specific information.												
TebuStar 3.6L	4	10	10	10	-	-	-	-	tebuconazole	triazole (3)	4 fl oz	30 days
<b>Remarks:</b> For use on barley and wheat. Read label for specific crop-use information.												
Tebuzol	4	10	10	10	-	-	-	-	tebuconazole	triazole (3)	2-4 fl oz	30 days
<b>Remarks:</b> For use on barley and wheat. Read label for specific crop-use information.												
Tilt	2	8	8	8	8	8	8	8	propiconazole	triazole (3)	2-4 fl oz	0 days for grain; 7 days for forage
<b>Remarks:</b> For use on barley, rye, oat, triticale, and wheat. Do not apply more than 8 fl oz/a/season. Do not apply more than 4 fl oz/a/season of Tilt if forage or hay will be harvested. Do not apply more than 0.22 lb ai propiconazole-containing products/a/season.												
Topaz	2	8	8	8	8	8	8	8	propiconazole	triazole (3)	2-4 fl oz	<b>Wheat:</b> Do not apply after Feekes 10.5 <b>Barley, oat, rye, triticale:</b> Do not apply within 30 days for forage or hay
<b>Remarks:</b> Do not apply more than 8 fl oz/a/season, or more than 0.22 lb ai/a propiconazole-containing product/season.												

Efficacy ratings: Excellent = 10; very good = 8; good = 6; fair = 4; poor = 2; no control = 0; labeled, no data = x; not labeled = -

<sup>a</sup> Fungicide group numbers indicate the modes of action: multiple applications of fungicides with same group number increases the chances for resistance.

Continued on next page

**Table 5-4.** Fungicides for control of foliar diseases of small grains (continued)

Fungicide	Fusarium head scab	Stripe rust	Leaf rust	Stem rust	Powdery mildew	Septoria leaf blotch	Glume blotch	Tan spot	Active ingredient(s)	Chemical family (FRAC code <sup>a</sup> )	Amount/use/a	Preharvest interval (PHI)
Trivapro	-	10	10	8	8	8	8	8	benzovindiflupyr + azoxystrobin + propiconazole	carboximides (7) + Qol (11) + triazole (3)	9.4 – 13.7 fl oz	Do not apply after Feekes 10.5.4
<b>Remarks:</b> Do not apply more than two applications before switching to a non-group 7 or 11 mode of action. The use of a spreading/penetrating adjuvant is recommended. Do not apply more than 27.4 fl oz per acre per year												
Twinline	-	10	10	8	6	8	8	10	pyraclostrobin + metconazole	Qol inhibitor (11) + triazole (3)	7-9 fl oz	Apply not later than the beginning of flowering (Zadoks 59 or Feekes 10.5); do not harvest barley hay within 14 days of last application
<b>Remarks:</b> For use in barley, oat, rye, triticale, and wheat. NO more than two applications of 18 fl oz /a/season.												
Viathon	x	x	x	x	x	x	x	x	Potassium phosphite + tebuconazole	phosphonate (33) + triazole (3)	2 pts.	30 days
<b>Remarks:</b> This product is only labeled for suppression of Fusarium head scab in barley. Fusarium head scab application should be made at Feekes 10.5.1 and will result in suppression only in barley and wheat. For glume blotch control, apply when 50% of wheat heads are in flower. Hay can be grazed or fed 6 days after application. Hay may be used as bedding.												

Efficacy ratings: Excellent = 10; very good = 8; good = 6; fair = 4; poor = 2; no control = 0; labeled, no data = x; not labeled = -

<sup>a</sup> Fungicide group numbers indicate the modes of action: multiple applications of fungicides with same group number increases the chances for resistance.

**Table 5-5.** Seed treatment fungicides for small grains<sup>a</sup>

Fungicide	Active ingredient(s)	Oat	Wheat		Barley		Seed/seedling decay
		all smuts	loose smut	bunt	loose smut	covered smut	
Allegiance FL	metalaxyl	-	-	-	-	-	<b>Barley, oat, rye, triticale, wheat</b>
Apron XL <sup>b</sup>	mefenoxam	-	-	-	-	-	<b>Barley, oat, rye, triticale, wheat</b> For protection against seed and seedling rot caused by <i>Pythium</i> on grain crops
Dividend Extreme Dividend XL RTA <sup>b</sup>	difenoconazole +mefenoxam	x	x	-	-	-	<b>Wheat</b> Protects against <i>Fusarium</i> spp. that are associated with “scabby” seed plus seed and seedling rots caused by <i>Pythium</i>
CruiserMaxx Vibrance Cereals <sup>b</sup>	sedaxane + difenoconazole + mefenoxam + thiamethoxam	x	x	x	x	x	<b>Barley, oat, rye, triticale, wheat</b>
Enhance	carboxin +captan	x	x	x	x	x	<b>Barley, oat, wheat</b>
Evergol Energy	prothioconazole + penflufen + metalaxyl	x	x	x	x	x	<b>Barley, oat, rye, wheat, triticale</b>
Manzate Flowable	mancozeb	x	-	x	-	x	<b>Barley, oat, rye, wheat</b>
Manzate Pro-Stik		x	-	x	x	x	<b>Barley, oat, wheat, triticale</b>
Dithane M-45		x	-	x	x	x	<b>Barley, oat, rye, wheat</b>
Penncozeb 75DF		x	-	x	x	x	<b>Barley, oat, rye, wheat</b>
Maxim 4FS	fludioxonil	x	x	-	-	-	<b>Barley, oat, rye, wheat</b> For control of seed-borne and soil-borne fungi that cause seed decay, damping-off, and seedling blights
NipsIt SUITE	metalaxyl +metconazole +clothianidin	x <sup>c</sup>	x	x	x	x	<b>Barley, oat, wheat</b>
Raxil Pro Shield	Imidacloprid + prothioconazole + tebuconazole +metalaxyl	-	x	x	-	-	<b>Barley, triticale, and Wheat</b> Protection against various root rots and damping off. Also effective against <i>Fusarium</i> spp. that are associated with “scabby” seed
Rizolex <sup>b</sup>	tolclofos-methyl	-	-	-	-	-	<b>Wheat</b> Damping off; also, protection against <i>Fusarium</i> spp. that are associated with “scabby” seed
Vibrance <sup>b</sup>	sedaxane	-	x	-	x	-	<b>Barley, oat, rye, triticale, wheat</b> For protection against seed and seedling rot caused by <i>Rhizoctonia solani</i>
Zeltera	Inpyrfluxam	-	x	-	x	-	For protection against seed and seedling rot caused by <i>Rhizoctonia solani</i>

Key: x = labeled, no data; - = not labeled for this disease

<sup>a</sup>This table is intended as a reference guide. Chemicals, combinations, and labels change frequently—check current label for details.<sup>b</sup>Also labeled for use on triticale.<sup>c</sup>Loose smut only.

# STORED GRAIN INSECT MANAGEMENT



# Stored grain insect management

**O**n-farm infestations of small grains are due primarily to insect-infested equipment and storage facilities and grain molds that attract fungus-feeding beetles. The best approach to this problem is to start with clean, dry grain and clean equipment and bins. Keeping grain dry and cool is of utmost importance to reduce problems with stored product insect pests.

Grain containing cracked kernels, weed seeds, or other foreign material tends to become infested more readily than sound, clean grain.

## Bin preparation

Clean out the bin before storing grain and avoid putting new grain on top of old grain. Remove all grain and debris from inside and outside bins well in advance of the harvest. This includes feed sacks, cardboard sheets and boxes, boards, and accumulations of grain, crusted grain, and dust. These products can harbor the eggs, larvae, pupae, and adults of stored product insect pests commonly called “bran bugs” and “grain moths.” Use brooms, vacuum cleaners, hoes, or other scrapers to do a thorough job. Make sure you wear an approved dust- and mold-filtering mask while cleaning bins.

Avoid storing grain near animal feeders, feed rooms, or in livestock dwellings. Spilled feed in these areas may harbor stored grain pests. Either feed the first few bushels from the combine to livestock or discard them. The old grain left in the combine could be infested.

Patch all holes in the bin to bar entry by birds and rodents. Make sure the roof does not leak.

## Empty bin treatments

After bins are emptied and cleaned, spray the inside surfaces to the point of runoff with an insecticide approximately 2 weeks prior to harvest. Apply one of the following insecticides listed below to the walls, ceilings, roof, and floors of all bins that will be used to store small grains for more than a few weeks.

Do not let the insecticide spray mix stand overnight; it may break down and result in poor control.

Spraying or fumigating empty bins is only a part of the program for preparing bins for harvest. Before bins are sprayed, they must be thoroughly cleaned. In addition, money spent spraying empty bins is wasted if the grain placed in the bin is not managed properly and is allowed to go out of condition.

### Adjourn SC (deltamethrin) for barley, corn, oat, popcorn, rice, rye, sorghum, and wheat

Dilute 0.25-1.5 fl. oz. of Adjourn SC with water to make 1 gallon of solution. Before storing or handling grain, apply finished spray to equipment, wall and floor surfaces of grain bins and warehouses at the rate of 1 gallon per 1000 sq. ft. but DO NOT allow run-off to occur.

### Centynal EC (deltamethrin)

Dilute 0.25-1.5 fl oz of Centynal insecticide to make 1 gallon of solution. Apply at a rate of 1 gal/1,000 sq ft to cover surfaces without causing dripping or runoff.

### Centynal Synergized Insecticide (deltamethrin + piperonyl butoxide)

Dilute 1-6 fl oz of Centynal Synergized Insecticide with water to make 1 gallon of solution. Before storing or handling grain, apply finished spray to equipment, wall and floor surfaces of grain bins and warehouses at the rate of 1 gallon per 1,000 sq ft but do not allow runoff to occur.

### DEsect (diatomaceous earth)

DEsect Diatomaceous Earth Insecticide should be dusted lightly, at an approximate rate of 1-2 lbs per 1000 ft<sup>2</sup> on all interior wall and floor surfaces of empty storage areas. Pay special attention to those areas of harborage for insects (cracks and crevices). DEsect is labelled for organic use.

### D-Fense SC (deltamethrin)

Dilute 0.25-1.5 fl oz of D-Fense SC insecticide to make 1 gallon of solution. Apply at a rate of 1 gal/1,000 sq ft to cover surfaces without causing dripping or runoff.

### Diacon-D IGR (methoprene)

Apply Diacon-D IGR at a rate of 1.5 oz per 1,000 sq ft of surface area. Pay particular attention to cracks, crevices, and voids where commodities may accumulate and attract pests. Wear a dusk mask and protective gloves.

### Diacon IGR (methoprene)

For a liquid spray, fill the mixing container with 1/2 gallon water, add 1 ml (1/30 fl oz) of DIACON® IGR, mix, and complete filling with a total of 1 gallon of water. Apply at a rate of 1 gallon of diluted solution per 1,000 square feet of surface area with any low-pressure sprayer typically used for indoor applications. Can also be applied with an aerosol generator according to label directions.

### Diacon IGR Plus (deltamethrin + methoprene)

Dilute 0.25-1.5 fl oz of Diacon IGR Plus insecticide to make 1 gallon of solution. Apply at a rate of 1 gal/1,000 sq ft but do not allow runoff to occur.

### Dryacide 100 (diatomaceous earth)

Apply at the rate of one to three pounds per 1,000 square feet of surface area, using mechanical dust applicator or power equipment suitable for the application of dusts. To apply Dryacide 100 as a slurry treatment, mix 1.5 lb of Dryacide 100 per gallon of water and apply 1.5 gallons of finished spray per 1,000 sq ft. Apply evenly for thorough coverage to the point of runoff.

---

### **EverGreen Crop Protection EC 60-6** (pyrethrins + piperonyl butoxide)

Spray all areas prior to use for storage with 1 part to 29 parts water (1 quart with 7.5 gallons water) up to 1 part to 11 parts (1 quart with 3 gallons water). Apply at the rate of one gallon per 750 sq. ft. on walls, floors, ceilings and partition boards of bins, paying particular attention to forcing the spray into all cracks and crevices.

---

### **Evergreen pyrethrum concentrate** (pyrethrins)

Spray all areas prior to use for storage with 1 part to 22 parts water (6 fluid ounces with one gallon of water) up to 1 part to 8 parts (1 pint with one gallon of water). Apply at the rate of one gallon per 750 square feet on walls, floors, ceilings and partition boards of bins. Evergreen is labeled for organic production.

---

### **Gravista** (deltamethrin + piperonyl butoxide + methoprene)

Dilute 1–6 fl oz of Gravista with water to make 1 gallon of solution. Before storing or handling grain, apply finished spray to equipment, wall and floor surfaces of grain bins and warehouses at the rate of 1 gallon per 1,000 sq ft but do not allow runoff to occur.

---

### **Nyguard IGR concentrate** (pyriproxyfen)

Apply as a surface application at the rate of 8 ml in one gallon of water to treat 1,500 sq ft. Use up to 12 ml per 1,500 sq ft. for insect populations that are difficult to control or in conditions that make it difficult to get control of target pests. Apply diluted spray as a spot treatment, surface application and crack and crevice spray.

---

### **Pydclear** (pyrethrins + piperonyl butoxide)

Using a dilution of 1 part concentrate in 29 parts water (4.3 fluid ounces per gallon), apply at a rate of 1 gallon to 750 square feet of surface with particular attention to cracks, crevices, and similar hiding places.

---

### **Pyronyl Crop Spray** (pyrethrins + piperonyl butoxide)

To treat the storage site prior to using it for storage, dilute 1 part of Pyronyl Crop Spray with 59 parts of water (1 pint with 7 gallons 3 pints of water) and apply to walls, floors, ceilings, and partition boards at the rate of 1 gallon per 750 sq. feet. It is important to thoroughly treat all cracks and crevices.

---

### **SureKill Evolve SC** (deltamethrin)

Dilute 0.25–1.5 fl. oz. of SureKill Evolve SC with water to make 1 gallon of solution. Before storing or handling grain, apply finished spray to equipment, wall and floor surfaces of grain bins and warehouses at the rate of 1 gallon per 1000 sq. ft. but DO NOT allow run-off to occur.

---

### **Suspend SC & Suspend Polyzone** (deltamethrin)

Dilute 0.25–1.5 fl oz to make 1 gallon of solution. Apply at a rate of 1 gal/1,000 sq ft to cover surfaces without causing dripping or runoff. Suspend SC & Suspend Polyzone can also be applied to the exterior of grain bins to help prevent entry by stored product insect pests.

---

### **Tempo SC Ultra** (cyfluthrin)

Use 8–16 mL (0.25 – 0.5 fl oz) Tempo SC Ultra per gallon of water (0.025 – 0.05%) and apply as a low-pressure general surface spray using a fan-type nozzle, or as a spot, mist or crack and crevice application. Reapply every 7 to 10 days if needed. Tempo may not be applied directly to stored grain, only to empty storage facilities or modes of transport. An insect growth regulator (IGR) may be mixed with Tempo pre-binning applications for long-term grain storage. Tempo SC can also be applied to the exterior of grain bins to help prevent entry by stored product insect pests.

---

### **Zeposector-SII** (pyrethrins + piperonyl butoxide)

Product is pre-mixed and ready to apply. Apply via a coarse droplet spray using approximately 1 gal. of material to each 750 sq. ft. of surface. Thoroughly spray floors, walls and other surfaces of bins, storage and handling areas with particular attention to cracks, crevices and similar protected locations. Spray all cracks and crevices and around doors. The plenum beneath irremovable perforated floors can harbor many insects and is difficult to treat. While directing extra spray through the perforations will kill some of the insects in this grain debris, it will not kill enough for satisfactory control. Thus, you will either have to fumigate or remove the subfloor to clean out grain debris. Some products allow for exterior bin treatments to help prevent the entry of stored product insect pests.

## **Grain protection with insecticides**

### **Direct grain treatment**

In Wisconsin, clean, dry grain suffers little, if any, damage on the farm during the first season's storage if (1) the preceding suggestions on bin sanitation and residual sprays are followed, (2) the grain is not stored close to livestock feed or other grains that are contaminated with insects, and (3) aeration is used to cool the grain and prevent insect feeding and reproduction.

A grain protectant should be used if the grain will be held beyond June 1 of the following year. However, a grain protectant will not protect grain from insects that feed on molds, such as the foreign grain beetle. Grain moisture of 14–18% is favorable for most stored grain insects. Insects that feed on mold prefer the high moisture ranges. Thus, proper grain drying and bin aeration are integral parts of managing stored grain insects. To help bin aeration, do not overfill bins; it hinders uniform airflow during aeration and makes it harder to inspect and treat the grain. Level the grain and allow at least 8 inches between the grain surface and the top of the bin wall.

Drying grain to 12–13% moisture is unfavorable for most grain insects and allows prolonged persistence of protectant insecticides added while the grain is being binned.

---

### **Actellic 5E** (pirimiphos-methyl) for corn, popcorn, and sorghum

Apply spray solution uniformly as grain enters storage according to label directions (6–8 ppm concentration). Actellic can only be used once during the entire storage period, regardless of the method of use. Do not apply Actellic to corn or sorghum that has been previously treated with a product containing pirimiphos-methyl. Do not apply Actellic to barley, oats, rye, wheat, or soybean.

**Adjourn SC** (deltamethrin) for barley, corn, oat, popcorn, rice, rye, sorghum, and wheat

Dilute with an FDA approved food grade mineral or soybean oil and apply to the moving grain stream as a coarse spray to provide a concentration of 0.5 ppm of deltamethrin on the grain. Final spray volume with water solutions is 5 gallons of liquid/1,000 bushels of grain.

**Centynal EC** (deltamethrin) for barley, corn, oat, popcorn, rice, rye, sorghum, and wheat

Apply to the moving grain stream as a coarse spray to provide a concentration of 0.5 - 1 ppm of Centynal EC on the grain. Maintain agitation before and during application. Use a mixed dilution within 48 hours of preparing.

### **Centynal Synergized Insecticide**

(deltamethrin + piperonyl butoxide) for barley, corn, oat, popcorn, rice, rye, sorghum, and wheat

Dilute Centynal<sup>TM</sup> Synergized with water or approved dust-controlling oils, mineral or soybean oils and apply to the moving grain stream as a coarse spray. Final spray volume with water solutions is 3–5 gallons of liquid per 1,000 bushels of grain. For rough rice, use 10 gallons of water per 1,000 bushels. Maintain agitation before and during application. Use a mixed dilution within 48 hours of preparing. Re-agitation of spray dilution may be required if left overnight.

**DEsect** (diatomaceous earth) for barley, corn, oat, rye, wheat, and other commodities

DEsect can be applied to the grain or other agricultural products at the time of storage and should be added at a point where sufficient blending can occur. Apply at a rate of 1 to 7 pounds per ton and mix throughout the grain mass. Uniformity of blend is important for efficient pest control. DEsect is labelled for organic use.

**D-Fense SC** (deltamethrin) for barley, corn, oat, popcorn, rice, rye, sorghum, wheat, and other commodities

Dilute with a food grade mineral or soybean oil and apply to the moving grain stream as a coarse spray to provide a concentration of 0.5 ppm of deltamethrin on the grain. Final spray volume with water solutions is 5 gallons of liquid/1,000 bushels of grain.

**Diacon-D** (methoprene) for corn, oat, popcorn, rice, sorghum, wheat, and other commodities

Unlike traditional insecticides, Diacon-D does not kill adult insects. This insect growth regulator interferes with the development of young insects, preventing breeding by adult beetles and moths. Apply 8-10 pounds of Diacon-D per 1,000 bushels of commodity. Apply the dust as uniformly as possible to the commodity stream to assure even coverage. Apply in such a manner to reduce the potential of the product blowing off target in windy conditions. The higher application rate will provide longer residual.

**Diacon IGR** (methoprene) for barley, corn, oat, rice, rye, sorghum, wheat, and other commodities

This insect growth regulator prevents breeding by beetles and moths; it does not kill adult insects. Final water or oil dilution volume is 5 gallons of liquid per 1,000 bushels of grain (or 21 oz per ton for grain). Apply diluted product to the moving grain stream as a uniform coarse spray.

**Diacon IGR Plus** (deltamethrin + methoprene) for barley, corn, oats, popcorn, rice, rye, sorghum, and wheat

Dilute with water or approved dust-controlling oils, mineral or soybean oils and apply to the moving grain stream as a coarse spray to provide a concentration of 0.5 ppm to 1 ppm of deltamethrin and 1.25 ppm or 2.5 ppm of S-methoprene on the grain. Final spray volume with water solutions is 3-5 gallons of liquid per 1,000 bushels of grain. Use the mixed solution within 48 hours of preparation.

**Dryacide 100** (diatomaceous earth) for barley, corn, oat, rice, rye, sorghum, wheat, and other commodities

Apply 1-2 lb per ton of grain (28-56 pounds per 1,000 bushels) during storage to prevent insect damage to grain. Thoroughly mix Dryacide 100 with grain. Dryacide 100 can be mixed into grain going into storage or can be applied via a layering method as described on the label. For best results, treat grains and seeds immediately after harvest.

**EverGreen Crop Protection EC 60-6** (pyrethrins + piperonyl butoxide) for barley, corn, oat, rice, rye, sorghum, wheat, and other commodities

Dilute at the rate of 1 part to 29 parts water (1 quart with 7.5 gallons water). Thoroughly mix the

emulsion and apply at the rate of 4 to 5 gallons per 1,000 bushels of grain as it is carried along a belt or as it enters the auger or elevator.

**Evergreen pyrethrum concentrate** (pyrethrins) for barley, corn, oat, rice, rye, sorghum, wheat, and other commodities

Dilute at the rate of 1 part to 22 parts water (6 fluid ounces with one gallon of water). Thoroughly mix the emulsion and apply at the rate of 5 gallons per 1,000 bushels of grain as it is carried along a belt or as it enters the auger or elevator. Evergreen is labeled for organic production.

**Gravista** (deltamethrin + piperonyl butoxide + methoprene) for barley, corn, oat, rice, rye, sorghum, and wheat

Dilute Gravista with water or approved dust-controlling oils, mineral or soybean oils and apply to the moving grain stream as a coarse spray. Final spray volume with water solutions is 3–5 gallons of liquid per 1,000 bushels of grain. For rough rice, use 10 gallons of water per 1,000 bushels. Maintain agitation before and during application. Consult product label for application rates for each crop to deliver a 0.5 ppm concentration of deltamethrin and 1.2 ppm of methoprene on the commodity.

**Pyronyl Crop Spray** (pyrethrins + piperonyl butoxide) for barley, corn, oat, rice, rye, sorghum, wheat, and other commodities

Dilute at the rate of 1 part Pyronyl Crop Spray with 29 parts water (1 pint with 3 gallons 5 pints water). Thoroughly mix the emulsion and apply at the rate of 4 to 5 gallons per 1,000 bushels of grain or seed as it is carried along a belt or as it enters the auger or elevator.

**Sensat** (spinosad) for barley, corn, oat, sorghum, wheat, and other commodities

Consult product label for application rates for each crop to deliver 1 ppm of active ingredient to grain stream. Solution is applied at a rate of 5 gallons of spray mixture per 1,000 bushels of grain.

**SureKill Evolve SC** (deltamethrin) for barley, corn, oat, popcorn, rice, rye, sorghum, wheat, and other commodities

Dilute SureKill Evolve SC with water or FDA approved food grade mineral or soybean oils and apply to the moving grain stream as a coarse spray to provide a concentration of 0.5 ppm of deltamethrin.

thrin on the grain.

Final spray volume with water solutions - 5 gallons of liquid per 1000 bushels of grain.

**Suspend SC** (deltamethrin) for barley, corn, oat, popcorn, rice, rye, sorghum, and wheat

Dilute Suspend SC Insecticide with water or FDA approved food grade mineral or soybean oils and apply to the moving grain stream as a coarse spray to provide a concentration of 0.5 ppm of deltamethrin on the grain. Final spray volume with water solutions-5 gallons of liquid per 1,000 bushels of grain.

## Grain surface treatments

### Top-dressing

Once grain is in the bin, surface treatments only are effective against insects feeding at the grain surface; insects feeding within the grain mass will not be controlled with these products. The following products are available for use as surface treatments.

**Actellic 5E** (pirimiphos-methyl) for corn, popcorn, and sorghum

Actellic 5E may be used as a surface treatment in stored corn and sorghum and will control Indian meal moths, beetles, and weevils. Do not apply Actellic to barley, oats, rye, wheat, or soybean. Actellic can only be used once during the entire storage period, regardless of the method of use. Mix 3.0 fl oz Actellic 5E in 2 gallons water per 1,000 sq ft of grain surface area. Refer to product label for detailed application instructions.

**Biobit HP** (*Bacillus thuringiensis*) for barley, oat, popcorn, rye, sorghum, soybeans, wheat, and other commodities

Biobit works only against caterpillar pests such as Indian meal moth and almond moth; it is not effective against weevils or other beetles, or other stored product insects. Biobit can be applied as a surface treatment. Apply 0.5 lb of product in 5-10 gallons of water per 500 sq ft of grain surface area. Mix treatment into the top 4 inches. Biobit HP is labeled for organic production.

**DEsect** (diatomaceous earth) for barley, corn, oat, rye, wheat, and other commodities

Apply DEsect Diatomaceous Earth Insecticide at a rate of 4 pounds per 1000 square feet of surface area over the top of the grain bed. If surface is disturbed so that protective barrier is breached, reapply DEsect Diatomaceous Earth Insecticide at a rate of 4 pounds per 1000 square feet. DEsect is labelled for organic use.

**Diacon-D** (methoprene) for barley, corn, oat, rice, rye, sorghum, wheat, and other commodities

This insect growth regulator prevents breeding by beetles and moths; it does not kill adult insects. Apply 8 pounds of Diacon-D per 1,000 sq ft of commodity surface area. Raking the top layer will enhance protection from invading insects infesting the top surfaces of the commodity. When raking commodity surface, rake to a depth of 1 foot.

**Diacon IGR** (methoprene) for barley, corn, oat, rice, rye, sorghum, wheat, and other commodities

This insect growth regulator prevents breeding by beetles and moths; it does not kill adult insects. Thorough coverage of the bins or storage areas is essential for optimal results. For surface treatments, apply 1 ml (1/30 oz) of Diacon IGR per 1,000 square feet in sufficient diluent to provide adequate coverage.

**DiPel** (*Bacillus thuringiensis*) for grains, soybeans, sunflower, popcorn, and other commodities

DiPel is a biological insecticide that contains a naturally occurring bacterial organism that kills moth larvae. It is labeled for surface treatment for control of Indian meal moth. This insecticide will not control beetles, weevils, or bran bugs. Apply 0.5 lb of product in 5-10 gallons of water per 500 sq ft of grain surface area. Mix treatment into the top 4 inches.

**Dryacide 100** (diatomaceous earth) for barley, corn, oat, rice, rye, sorghum, wheat, and other commodities

As a top-dressing treatment, apply 2-3 lbs of Dryacide 100 per 1,000 sq ft of grain surface area. For best results, combine layer treatment technique with an empty bin treatment prior to storage of grain.

**EverGreen Crop Protection EC 60-6** (pyrethrins + piperonyl butoxide) for barley, corn, oat, rice, rye, sorghum, wheat, and other commodities

If the top two or three inches are infested, dilute 2.5 fl. oz. EVERGREEN Crop Protection EC 60-6 with up to 2 gallons of water and apply at the rate of 1 to 2 gallons per 1,000 sq. ft. of grain. Rake the mixture into the grain to a depth of 4 inches.

**Evergreen pyrethrum concentrate** (pyrethrins) for barley, corn, oat, rice, rye, sorghum, wheat, and other commodities

To kill Indian Meal Moths, Angoumois Grain Moths and Mediterranean Flour Moths, monthly inspections should be made after the grain is placed in storage. If the top two or three inches are infested, dilute 1 part Evergreen with 14 parts of water and apply at the rate of 2 gallons per 1,000 square feet of grain. Rake the mixture into the grain to a depth of 4 inches. Evergreen is labeled for organic production.

**Javelin WG** (*Bacillus thuringiensis*) for grains and soybeans

Javelin WG is a biological insecticide that contains a naturally occurring bacterial organism that kills moth larvae. It is labeled for surface treatment for control of Indian meal moth. This insecticide will not control beetles, weevils, or bran bugs. To apply Javelin WG as a top-dressing treatment, mix 1.5 oz (weight) per gallon of water to treat the upper 4 inches of grain. Javelin WG is labeled for organic production.

**Pyleclear** (pyrethrins + piperonyl butoxide) for all commodities

To kill exposed accessible stages of Indian meal moths and Angoumois grain moths in stored grain: Dilute 1 part of concentrate in 14 parts of water (8.6 fluid ounces per gallon) and apply to the surface of the binned grain at a rate of 2 gallons per 1,000 square feet (1.6 pints per 100 square feet). Apply at monthly intervals beginning with the first appearance of moths and continuing until early fall. In case of severe infestation, break up webbing with rake before spraying and make a second application in two weeks.

## Pyronyl Crop Spray (pyrethrins + piperonyl butoxide) for barley, corn, oat, rice, rye, sorghum, wheat, and other commodities

To kill Indian meal moths, Angoumois grain moths and Mediterranean flour moths, monthly inspections should be made after the grain is placed in storage. If the top 2 or 3 inches are infested, dilute 1 part of Pyronyl Crop Spray with 19 parts of water and apply at the rate of 1 to 2 gallons per 1,000 square feet of grain. Rake the mixture into the grain to a depth of 4 inches.

## Sensat (spinosad) for barley, corn, oat, popcorn, sorghum, wheat, and other commodities

Top dressing treatments are not as effective as treating the full grain column, but they can provide significant protection from some insects such as Indian meal moth. For each 1,000 sq ft of surface, mix 2.6 fl oz of Sensat in 2.0 gallons of water. Apply one-half of the total application amount evenly across the surface and then rake to a depth of at least 4 inches. Complete the treatment by applying the remaining half to the surface and leave undisturbed.

## Indian meal moth

This insect is a problem in portions of Wisconsin. The adult (moth) does not damage stored grains, but the larvae feed in the upper few inches of the grain mass and will web the grain together. If populations are great, the surface will be crusted, protecting the larvae from surface-applied insecticides or fumigants.

This pest has developed resistance to malathion in many areas; as a result malathion is no longer suggested for controlling this pest. There are several alternatives to malathion that are specific to stored grain: dichlorvos vapor strips (for bin headspace treatments); Actellic 5E (corn and sorghum); *Bacillus thuringiensis* (corn, small grains, soybeans); diatomaceous earth (corn, small grains, soybeans); methoprene (corn, small grains, and other commodities); pyrethrins (corn, small grains, and other commodities) and spinosad (corn, small grains, soybeans).

- A preventative treatment is to suspend dichlorvos (DDVP, vapona) resin strips over the stored grain. Consult product labels to determine the appropriate number of strips for a given area. Use and follow label directions. This technique is effective against adults only. The strip must be hung before moths begin to emerge in early spring and usually must be replaced every 6 weeks. During the first season of storage, the strips should be hung immediately after small grains are binned.
- Biobit, Dipel, and Javelin WG are biological insecticides that contain a naturally occurring bacterial organism (*Bacillus thuringiensis* subsp. *kurstaki*) that kills moth larvae when ingested. It can be used to control Indian meal moth larvae. It will not control adult moths, nor will it control weevils or beetles. Consult the product label for rates and special application instructions. Biobit, Dipel, and Javelin are all labeled for organic production.
- Evergreen, EverGreen 60-6, Pyclear, and Pyronyl Crop Spray contains pyrethrins and are labelled for surface treatments for Indian Meal Moth and other insects. Evergreen is approved for organic production. EverGreen 60-6, Pyclear, and Pyronyl Crop Spray also contains the synergist piperonyl butoxide.
- DEsect and Dryacide contain diatomaceous earth and are labeled as a surface treatment for Indian meal moth and may be used on barley, corn, oat, rye, sorghum, wheat, and other commodities. Insects that come in contact with the product are scraped by the microscopic particles. They lose their body fluids, become dehydrated, and die. This is a physical control, so insects have difficulty building up resistance. DEsect is labeled for organic production.
- Diacon-D, Diacon IGR, and Gravista contain the insect growth regulator methoprene. Methoprene disrupts the growth process of insect larvae (such as Indian meal moth caterpillars) but will not affect the adult insects. Diacon-D and Diacon IGR are labeled for use as direct grain or top-dressing treatments.
- Sensat (spinosad) is also approved for surface treatments and can provide significant control of Indian meal moths. Consult the product label for application rates and instructions.

Before applying a grain surface treatment for Indian meal moth, remove webbing or crusted or spoiled grain. Follow application instructions for insecticides listed in the **Grain Surface Treatment** section.

It may take several weeks for grain surface treatments to control an Indian meal moth infestation. You may want to hire a fumigator for faster results. If you'll be keeping the grain in storage, treat the grain surface with an appropriate insecticide listed under the **Grain Surface Treatment** section to prevent reinfestation once it is safe to enter the bin after fumigation.

## Grain inspection

Stored grain should be inspected every 2-4 weeks from May through October and at least monthly from November-April. If infestations are detected early, they can be controlled before extensive damage occurs.

Check various areas of the grain mass with a grain probe. Sift the grain samples through a screen (10-12 mesh to the inch) to separate the insects from the grain. If insects are found, fumigation may be necessary.

Probe traps and pitfall traps can be used for monitoring the grain mass, and sticky pheromone traps can be used to monitor flying moths. It also is important to probe the grain in several locations to monitor grain temperature and moisture.

## Safety precautions

Stored grain, especially flowing grain, presents many hazards. Following is a list of important safety precautions (adapted from the University of Illinois *Pesticide Training Manual for Grain Facility Pest Control Applicators*).

**Table 6-1.** The number of live insects required for FGIS designations as infested

Crop	Insect density/kg of grain
wheat, rye	Two or more live insects that are injurious to stored grain
barley, corn, oats, sorghum, soybeans	More than one live weevil, <b>or</b> One live weevil plus five or more other live pest insects, <b>or</b> No live weevils but 10 or more other live pest insects

- Do not enter a bin of flowing grain.
- Do not enter a bin to break a crust or remove a blockage when unloading equipment is running, whether or not grain is flowing. Restarted flow is a hazard.
- Before entering a bin, lock out the circuit controlling the unloading equipment and post a warning so no one else starts the equipment.
- Do not enter a bin without knowledge of previous grain removal practices, especially if crusting is evident.
- Do not trust a surface crust to remain intact.
- Do not depend on a second person to start or stop equipment according to shouted instructions. Equipment noise can prevent communication. The second person may be unable to complete the task soon enough.
- When entering a bin that contains poor quality grain or when unloading history is unknown, have two workers outside the bin. The person in the bin should wear a safety

rope. The companions outside the bin should be able to lift him or her out without entering the bin. One outside companion cannot do this. And having two companions present allows one to administer first aid while the other goes for help.

- Always wear a particle respirator capable of filtering fine dust and mold spores when working inside a bin; grain dust and molds are a health hazard.
- Keep children away from equipment, vehicles, and flowing grain.
- Avoid working in overfilled, peaked bins; crawling about in these bins can cause grain flows that block exits.
- Maintain proper and effective shields and guards on hazardous equipment.

## Controlling established infestations

To date, most insect problems in grain stored on Wisconsin farms are the result of improper storage. The development of grain molds makes stored grain attractive to foreign grain beetles and flat grain beetles.

When insects are found in stored grains, you must first correct storage conditions that allow the grain to deteriorate and then determine whether the infestation warrants control. The importance of an insect infestation is determined not only by the number of insects present, but also by type of grain, insect species, time of year, grain temperature and moisture, the planned length of storage, market potential, and local elevator quality and dockage guidelines. Insect-damaged kernels may result in price discounts. Also consider that insect populations and their damage can increase rapidly. Table 6-1 lists the Federal Grain Inspection Service standards for grain infestation that will be in effect until further notice, but local elevators usually enforce more stringent standards.

If you find insects in stored grain, consider several possible manage-

ment options. Sometimes the most profitable option may be to clean and sell the grain immediately without any chemical treatment. Immediate sale is especially appropriate where early stages of insect infestations are detected before insect numbers reach elevator dockage or discount levels.

Sometimes insect problems are limited primarily to the surface or central core of stored grain. If Indian meal moth is the only problem, you can control light infestations by using Actellic (corn and sorghum), *Bacillus thuringiensis* (corn, small grains, soybeans), diatomaceous earth (corn, small grains, soybeans); methoprene (corn and small grains), pyrethrins (corn and small grains), or spinosad (corn, small grains, soybeans) in conjunction with dichlorvos strips as outlined in the section on the Indian meal moth. Where abundant webbing indicates a severe infestation, rake webbing from the surface before treatment; fumigation may be necessary in this situation. Where bran bugs are the problem and are confined primarily to a central core of fine material, remove one or two loads of grain to extract that core, allowing safe storage of the remaining grain.

Where infested grain can be moved to a clean bin, transfer and treatment with a protectant insecticide is recommended. If possible, use a grain cleaner during the transfer process. Protectant insecticides will not immediately kill immature insects within grain kernels, but residues eventually provide control and protect against reinfestation for a period dependent upon grain moisture and temperature.

## Fumigation

Infested grain that cannot be treated successfully in any other way should be fumigated. Fumigation of farm-stored grain is difficult, hazardous, and requires special training and equipment.

You must receive supplemental certification to apply fumigants. If

you are a certified private applicator, you must receive additional certification in the **Agricultural Fumigation subcategory**. Commercial applicators must be certified in the **Space and Commodity Fumigation category**.

All fumigants are extremely toxic and dangerous if improperly used. Use them in strict accordance with label directions and follow all safety precautions. Failure to follow all label instructions is unsafe and illegal.

Always work in pairs; an observer should be present outside the bin. Labeling requires the use or availability of an NIOSH approved air-purifying full face respirator approved for phosphine or a self-contained breathing apparatus for respiratory protection during one or more stages of the fumigation process. Fumigators also must measure fumigant gas concentrations to determine that the fumigant has dissipated sufficiently before unprotected persons can enter the fumigated space. Follow specific label directions concerning respiratory protection equipment and gas detection devices. If you are uncertain about the safe use of a fumigant, contact the manufacturer for detailed instructions.

These steps are suggested for fumigation:

1. Level the grain; the grain surface must be 8 inches or more below the bin lip to allow good aeration plus sufficient space for inspection and treatment. Remove or break up any caked or crusted area.
2. Use tape and plastic sheeting to thoroughly seal all cracks and holes in the bin, including eaves, hatches, side doors, unloading auger shaft, and fan openings. Leave only the necessary access openings to seal after fumigant application.
3. Fumigate on a still day when the grain temperature is above 60°F. Wind causes rapid gas leakage and will reduce the effectiveness of the fumigation.

The method of application will vary with the type of fumigant, com-

modity, and storage facility. Apply the product at labeled rates and follow all safety precautions.

**Phosphine.** This is available in solid formulations of aluminum or magnesium phosphate and is used for fumigation of insect-infested grain. When exposed to heat and moisture, the formulations release phosphine, a highly toxic gas. Even moisture from hands can activate the pellets, so gloves must be used.

4. Seal all access doors to the bin. Place warning signs as directed by the fumigant label.
5. Keep the bin closed for at least 72 hours before airing out bins following aluminum phosphide fumigation. Do not enter the bin during or after fumigation until gases have been thoroughly removed by aeration.

Fumigated grain must be aerated thoroughly before processing or feeding. Once it is aired out, fumigated grain may become reinfested. Surface application of protectant insecticide and/or placement of dichlorvos resin strips should follow fumigation if storage is to continue. If the infestation was a result of poor grain storage practices, these conditions must be corrected.

## Notes:

## APPENDIX



**Table 7-1.** Herbicide products and related information

Commercial name	Formulation <sup>a,b</sup>	Active ingredient(s)	Site of Action WSSA Group # <sup>c</sup>	Manufacturer	RUP <sup>a</sup>	Signal word	REI <sup>a,d</sup>
2,4-D Amine 4, Shredder	3.8L	2,4-D	4	WinField	—	danger	48 hr
2,4-D LV4, Shredder	3.8L	2,4-D	4	WinField	—	caution	12 hr
AAtrex	4L, 90DF	atrazine	5	Syngenta	yes	caution	12 hr <sup>e</sup>
Accent Q	54.5DF	nicosulfuron+safener	2 + —	Corteva		caution	4 hr
Acuron	23+11+3	S-metolachlor+atrazine +mesotrione+bicyclopyrone	15 + 5 + 27 + 27	Syngenta	yes	caution	24 hr
Acuron GT	2 + 2 + 0.2 + 0.095 ZC	glyphosate + S-metolachlor +mesotrione+bicyclopyrone	9 + 15 + 27 + 27	Syngenta	no	caution	24 hr
Acuron Flexi	2.86+0.32+0.08	S-metolachlor +mesotrione+bicyclopyrone	15 +27 + 27	Syngenta	no	caution	24 hr
Affinity BroadSpec	25+ 25SG	thifensulfuron+ tribenuron	2 + 2	FMC	—	caution	12 hr
Afforia	50.8DG	tribenuron + thifensulfuron + flumioxazin	2 + 2 + 14	Corteva	—	caution	12 hr
Anthem	2.15SE	pyroxasulfone + zfluthiacet-methyl	15 + 14	FMC	—	caution	12 hr
Anthem Flex	3.7+0.3 SE	pyroxasulfone + carfentrazone	15 + 14	FMC	—	caution	12 hr
Anthem Maxx	45+1.4 SC	pyroxasulfone + fluthiacet-methyl	15 + 14	FMC	—	caution	12 hr
Anthem ATZ	42+5+0.2 SE	atrazine + pyroxasulfone + fluthiacet-methyl	5 + 15 + 14	FMC	—	warning	12 hr
Armezon	2.8 SC	topramezone	27	BASF	no	caution	12 hr
Armezon PRO	0.1 + 5.25 EC	topramezone + dimethenamid-P	27 + 15	BASF	no	caution	12 hr
Assure II	0.88EC	quizalofop	1	AMVAC	—	danger	12 hr
Atrazine, others	90DF, 4L	atrazine	5	several	yes	caution	12 hr <sup>e</sup>
Authority Assist	3.33 + 0.67S	sulfentrazone+ imazethapyr	14 + 2	FMC	—	caution	12 hr
Authority Edge	2.73 + 1.52 SC	sulfentrazone + pyroxasulfone	14 + 15	FMC	—	caution	12 hr
Authority Elite	7L	sulfentrazone + S-metolachlor	14 + 15	FMC	—	caution	24 hr <sup>e</sup>
Authority First	62.1+ 7.9DF	sulfentrazone+ cloransulam	14 + 2	FMC	—	caution	12 hr
Authority Maxx	0.62 + 0.04 SC	sulfentrazone+ chlorimuron	14 + 2	FMC	—	caution	12 hr
Authority MTZ	0.18+ 0.27DF	sulfentrazone+ metribuzin	14 + 5	FMC	—	caution	12 hr
Authority Supreme	2.08 + 2.08 SC	sulfentrazone + pyroxasulfone	15 + 14	FMC	—	caution	12 hr
Autumn Super 51 WDG	0.06+ 0.45DF	iodosulfuron+ thienencarbazone	2 + 2	Bayer	—	caution	12 hr
Balance Flexx	2L	isoxaflutole	27	Bayer	yes	caution	12 hr
Banvel	4S	dicamba	4	Arysta	—	caution	24 hr
Basagran 5L	5L	bentazon	6	BASF	—	caution	48 hr
Basis Blend	20 + 10DF	rimsulfuron + thifensulfuron	2 + 2	Corteva	—	caution	4 hr
Bicep II Magnum	2.4 + 3.1L	S-metolachlor + atrazine + safener	15 + 5 + —	Syngenta	yes	caution	24 hr <sup>e</sup>
Bicep Lite II Magnum	3.33 + 2.67L	S-metolachlor + atrazine + safener	15 + 5 + —	Syngenta	yes	caution	24 hr <sup>e</sup>
Boundary 6.5	5.25+ 1.25L	S-metolachlor + metribuzin	15 + 5	Syngenta	—	caution	12 hr <sup>e</sup>

See endnotes following table 8-3

Continued on next page

**Table 7-1.** Herbicide products and related information (continued)

Commercial name	Formulation <sup>a,b</sup>	Active ingredient(s)	Site of Action WSSA Group # <sup>c</sup>	Manufacturer	RUP <sup>a</sup>	Signal word	REI <sup>a,d</sup>
Broadaxe XC	7.6+68	sulfentrazone + S-metolachlor	14 + 15	Syngenta	—	caution	24 hr
Brox 2EC	42EC	bromoxynil	6	Albaugh	—	warning	24 hr
Butyrac 200	2S	2,4-DB amine	4	Albaugh	—	danger	48 hr
Cadet	0.91EC	fluthiacet-methyl	14	FMC	—	warning	12 hr
Callisto	4L	mesotrione	27	Syngenta	—	caution	12 hr <sup>e</sup>
Callisto Xtra	0.5 + 3.2L	mesotrione + atrazine	27 + 5	Syngenta	—	caution	12 hr
Canopy Blend	64.3+10.7DF	metribuzin + chlorimuron	5 + 2	Corteva	—	caution	12 hr
Canopy EX	22.7 + 6.8DF	chlorimuron+ tribenuron	2 + 2	Corteva	—	caution	12 hr
Capreno	0.57 + 2.88L	thiencazone+ tembotrione + safener	2 + 27 + —	Bayer	—	caution	12 hr
Chaparral	62.1 + 9.5DF	aminopyralid + metsulfuron	4 + 2	Corteva	—	warning	48 hr
Chateau	51WG	flumioxazin	14	Valent	—	caution	12 hr
Cimarron Max	Part A: 60DF Part B: 1 + 2.87S	metsulfuron+dicamba + 2,4-D	2 + 4 + 4	Bayer	—	danger	48 hr
Cimarron Plus	48 + 15DF	metsulfuron + chlorsulfuron	2 + 2	Bayer	—	caution	4 hr
Cimarron X-tra	30 + 37.5DF	metsulfuron + chlorsulfuron	2 + 2	Bayer	—	caution	4 hr
Clarity	4S	dicamba	4	BASF	—	caution	24 hr
Classic	25DF	chlorimuron	2	Corteva	—	caution	12 hr
Cobra	2EC	lactofen	14	Valent	—	danger	12 hr
Corvus	2.63L	isoxaflutole + thiencazone	27 + 2	Bayer	yes	caution	12 hr
Crossbow <sup>f</sup>	1+ 2EC	triclopyr + 2,4-D ester	4 + 4	many	—	caution	—
Curtail	0.38S + 2.0S	clopyralid + 2,4-D amine	4 + 4	Corteva	—	danger	48 hr
Degree XTRA	2.7 + 1.34 ME	acetochlor + atrazine + safener	15 + 5 + —	Bayer	yes	caution	12 hr <sup>e</sup>
Diflexx	4L	dicamba	4	Bayer	—	caution	24 hr
Diflexx Duo	4L	dicamba + tembotrione	4 + 27	Bayer	—	caution	24 hr
Dual Magnum	7.64EC	S-metolachlor	15	Syngenta	—	caution	24 hr <sup>e</sup>
Dual II Magnum	7.64EC	S-metolachlor + safener	15 + —	Syngenta	—	caution	24 hr <sup>e</sup>
DuraCor	SC	aminopyralid + florypyrauxifen	4 + 4	Corteva	no	—	48 hr
Engenia	5 SL	dicamba (BAPMA salt)	4	BASF	yes	caution	24 hr
Enlist Duo	22 + 24 L	glyphosate + 2,4-D choline	9 + 4	Corteva	—	warning	48 hr
Enlist One	3.8 L	2,4-D choline	4	Corteva	—	warning	48 hr
Enlite	2.85 + 36.21 + 8.8DF	chlorimuron + flumioxazin + thifensulfuron	2 + 14 2	Corteva	—	caution	12 hr
Envive	9.2 + 29.2 + 2.9DF	chlorimuron + flumioxazin + thifensulfuron	2 + 14 + 2	Corteva	—	caution	12 hr
Eptam	7EC, 20G	EPTC	8	Syngenta	—	caution	12 hr <sup>e</sup>
Escort XP	60DF	metsulfuron	2	Bayer	—	caution	4 hr
Express	50DS	tribenuron	2	FMC	—	caution	12 hr
Extreme	0.17 + 2S	imazethapyr + glyphosate	2 + 9	BASF	—	warning	48 hr
Fierce	33.5 + 42.5 WDG	flumioxazin + pyroxasulfone	14 + 15	Valent	—	caution	12 hr
Fierce EZ	1.34 + 1.7 SC	flumioxazin + pyroxasulfone	14 + 15	Valent	—	caution	12 hr

See endnotes following table 8-3

Continued on next page

Principles of pest  
management

Corn weeds

Soybean

Forages &  
pastures

Small grains

Stored grain  
insects

Appendix

**Table 7-1.** Herbicide products and related information (continued)

Commercial name	Formulation <sup>a,b</sup>	Active ingredient(s)	Site of Action WSSA Group # <sup>c</sup>	Manufacturer	RUP <sup>a</sup>	Signal word	REI <sup>a,d</sup>
Fierce MTZ	0.5 + 0.64 + 1.5 SC	flumioxazin + pyroxasulfone + metribuzin	14 + 15 + 5	Valent	—	caution	12 hr
Fierce XLT	24.6 + 6.7 + 31.2	flumioxazin + chlorimuron + pyroxasulfone	14 + 2 + 15	Valent	—	caution	12 hr
FirstRate	84DF	cloransulam	2	AMVAC	—	caution	12 hr <sup>e</sup>
Flexstar	1.88S	fomesafen	14	Syngenta	—	warning	24 hr
Flexstar GT 3.5	0.56 + 2.26 EC	fomesafen + glyphosate	14 + 9	Syngenta	—	caution	24 hr
ForeFront HL	0.417 + 3.33SC	aminopyralid + 2,4-D	4 + 4	Corteva	—	danger	48 hr
Fultime NXT	2.7 + 1.34	acetochlor + atrazine	15 + 5	Corteva	—	caution	12 hr
Fusilade DX	2EC	fluzafop	1	Syngenta	—	caution	12 hr
Fusion	2 + 0.66EC	fluzafop + fenoxaprop	1 + 1	Syngenta	—	caution	24 hr
Gramoxone SL 3.0L	3.0L	paraquat	22	Syngenta	yes	danger	12 hr <sup>g</sup>
Halex GT	2.09 + 2.09 + 0.209L	S-metolachlor + glyphosate + mesotrione	15 + 9 + 27	Syngenta	—	caution	24 hr <sup>e</sup>
Harmony Extra	16.7 + 33.3SG	tribenuron + thifensulfuron	2 + 2	FMC	—	caution	12 hr
Harmony SG	50SG	thifensulfuron	2	FMC	—	caution	4 hr
Harness	7EC	acetochlor + safener	15 + —	Bayer	—	warning	12 hr <sup>e</sup>
Harness MAX	3.5 + 0.3L	acetochlor + mesotrione	15 + 27	Bayer	—	caution	12 hr <sup>e</sup>
Harness XTRA	4.3 + 1.7L	acetochlor + atrazine + safener	15 + 5	Bayer	yes	caution	12 hr <sup>e</sup>
Harness XTRA 5.6L	3.1 + 2.5L	acetochlor + atrazine + safener	15 + 5 + —	Bayer	yes	caution	12 hr <sup>e</sup>
Hornet WDG	18.5 + 50WG	flumetsulam + clopyralid	2 + 4	AMVAC	—	warning	48 hr <sup>e</sup>
Huskie	0.3 + 1.75EC	pyrasulfotole + bromoxynil + safener	27 + 5 + —	Bayer	—	warning	12 hr
Huskie Complete	0.5 + 2.8 + 22.6	thien carbazon + pyrasulfotole + bromoxynil	2 + 27 + 6	Bayer	—	danger	24 hr
Impact	2.8 SC	topramazone	27	AMVAC	—	caution	12 hr
ImpactZ	0.26 + 4 SC	topramezone + atrazine	27 + 5	AMVAC	yes	caution	12 hr
Impact Core	0.071 + 7.08 SC	topramezone + acetochlor	27 + 15	AMVAC	no	warning	12 hr <sup>e</sup>
Instigate	4.17 + 41.67WC	rimsulfuron + mesotrione	2 + 27	Corteva	—	caution	12 hr
Katagon	1 + 1 OD	tolpyralate + nicosulfuron	27 + 2	Helm Agro	—	caution	12 hr
Keystone NXT	3.1 + 2.5L	acetochlor + atrazine + safener	15 + 5 + —	Corteva	yes	caution	12 hr <sup>e</sup>
Keystone LA NXT	4.3 + 1.7L	acetochlor + atrazine + safener	15 + 5 + —	Corteva	yes	caution	12 hr <sup>e</sup>
Laudis	3.5L	tembotrione + safener	27 + —	Bayer	—	caution	12 hr
Lexar EZ	1.74 + 1.74 + 0.224 SC	S-metolachlor + atrazine + mesotrione	15 + 5 + 27	Syngenta	yes	caution	24 hr <sup>e</sup>
Liberty 280 SL	2.34S	glufosinate	10	BASF	—	warning	12 hr
Lorox	50DF	linuron	7	NovaSource	—	caution	24 hr
Lumax EZ	2.49 + 0.935 + 0.249 SC	S-metolachlor + atrazine + mesotrione	15 + 5 + 27	Syngenta	yes	caution	24 hr <sup>e</sup>
Marvel	0.117 + 2.883EC	fluthiacet-methyl + fomesafen	14 + 14	FMC	—	warning	24 hr
Maverick	0.829 + 0.693 + 0.693 SC	mesotrione + clopyralid + pyroxasulfone	27 + 4 + 15	Valent	—	caution	12 hr

See endnotes following table 8-3

Continued on next page

Principles of pest  
management

Corn weeds

Soybean

Forages &  
pastures

Small grains

Stored grain  
insects

Appendix

**Table 7-1.** Herbicide products and related information (continued)

Commercial name	Formulation <sup>a,b</sup>	Active ingredient(s)	Site of Action WSSA Group # <sup>c</sup>	Manufacturer	RUP <sup>a</sup>	Signal word	REI <sup>a,d</sup>
MCPA Amine	3.7L	MCPA	4	WinField	—	danger	48 hr
MCPA LV4 Ester	3.7L	MCPA	4	Nufarm	—	warning	12 hr
Metribuzin	75DF	metribuzin	5	many	—	caution	12 hr <sup>e</sup>
Milestone	2.0S	aminopyralid	4	Corteva	—	caution	12 hr
NorthStar	7.5 + 39.9DF	primisulfuron + dicamba	2 + 4	Syngenta	—	caution	12 hr <sup>e</sup>
OpTill	17.8 + 50.2WG	saflufenacil + imazethapyr	14 + 2	BASF	—	caution	12 hr
OpTill Pro	50WG + 6EC	saflufenacil + imazethapyr + dimethenamid	2 + 14 + 15	BASF	—	warning	12 hr <sup>e</sup>
Orion	0.033 + 2.34S	florasulam + MCPA	2 + 4	Syngenta	—	caution	12 hr
Outlook	6EC	dimethenamid-P	15	BASF	—	warning	12 hr <sup>e</sup>
Overdrive	50 + 20DS	dicamba + diflufenzopyr	4 + 19	BASF	—	caution	12 hr
Panther PRO	0.56 + 0.67 + 3 L	imazethapyr + flumioxazin + metribuzin	2 + 14 + 5	Nufarm	—	caution	12 hr
Permit	75DF	halosulfuron	2	Gowan	—	caution	12 hr
Phoenix	2EC	lactofen	14	Valent	—	danger	12 hr
Poast	1.5EC	sethoxydim	1	BASF	—	warning	12 hr
Poast Plus	1EC	sethoxydim	1	BASF	—	caution	12 hr
Prefix	4.34 + 0.95EC	S-metolachlor + fomesafen	15 + 14	Syngenta	—	warning	24 hr
Preview 2.1SC	2.23 + 1.12SC	metribuzin + sulfentrazone	5 + 14	UPL	—	caution	12 hr
Princep	90DF, 4L	simazine	5	Syngenta	—	caution	12 hr <sup>e</sup>
Prowl H <sub>2</sub> O	3.8ME	pendimethalin	3	BASF	—	caution	24 hr <sup>e</sup>
Pursuit	2S, 70DF	imazethapyr	2	BASF	—	warning	12 hr <sup>e</sup>
Python	80DF	flumetsulam	2	AMVAC	—	caution	12 hr <sup>e</sup>
Raptor	1EC	imazamox	2	BASF	—	caution	4 hr <sup>e</sup>
Realm Q	7.5 + 31.25DF	rimsulfuron + mesotrione + safener	2 + 27 + —	Corteva	—	caution	12 hr
Remedy Ultra	60.5 L	triclopyr	4	Corteva	—	caution	until dry
Resicore	2.8 + 0.3 + 0.19 SC	acetochlor + mesotrione + clopyralid	15 + 27 + 4	Corteva	—	caution	12 hr
Resicore XL	2.8 + 0.27 + 0.29 SC	acetochlor + mesotrione + clopyralid	15 + 27 + 4	Corteva	—	caution	24 hr
Resolve Q	18.4 + 4DF	rimsulfuron + thifensulfuron + safener	2 + 2 + —	Corteva	—	caution	4 hr
Resource	0.86EC	flumiclorac	14	Valent	—	warning	12 hr
Restraint	0.094 + 6.404EC	tolpyralate + acetochlor	27 + 15	Summit Agro	—	caution	12 hr
Revulin Q	14 + 37	nicosulfuron + mesotrione	2 + 27	Corteva	—	caution	12
Roundup PowerMAX	4.5S	glyphosate	9	Bayer	—	caution	4 hr
Select	2EC	clethodim	1	Valent	—	warning	24 hr
Select Max	0.97EC	clethodim	1	Valent	—	warning	24 hr
Sequence	2.25 + 3EC	glyphosate + S-metolachlor	9 + 15	Syngenta	—	caution	24 hr
Sharpen	2.85SC	saflufenacil	14	BASF	—	caution	12 hr
Shieldex	3.33SC	tolpyralate	27	Summit Agro	—	caution	12 hr
Sinate	2.47 + 0.1 L	glufosinate + topramezone	10 + 27	AMVAC	—	caution	12 hr
Sonic	62.1 + 7.9DF	sulfentrazone + cloransulam	14 + 2	Corteva	—	caution	12 hr
Spartan	4F	sulfentrazone	14	FMC	—	caution	12 hr <sup>e</sup>

See endnotes following table 8-3

Continued on next page

**Table 7-1.** Herbicide products and related information (continued)

Commercial name	Formulation <sup>a,b</sup>	Active ingredient(s)	Site of Action WSSA Group # <sup>c</sup>	Manufacturer	RUP <sup>a</sup>	Signal word	REI <sup>a,d</sup>
Spike <sup>f</sup>	20G	tebuthiuron	7	Corteva	—	caution	—
Starane	1.5EC	fluroxypyr	4	Corteva	—	warning	12 hr
Status	40 + 16DF	dicamba + diflufenzopyr + safener	4 + 19 + —	BASF	—	caution	24 hr
Steadfast Q	25.2+ 12.5DF	nicosulfuron + rimsulfuron + safener	2 + 2 + —	Corteva	—	caution	4 hr
Stinger	3S	clopyralid	4	Corteva	—	caution	12 hr
Stinger HL	5L	clopyralid	4	Corteva	—	caution	12 hr
Storen	2.69+0.15+0.31 +0.075 ZC	S-metolachlor+pyroxasulfone + mesotrione+bicyclopyrone	15+15+27+27	Syngenta	no	caution	24 hr
SureStart II	3.75+ 0.38+ 0.12L	acetochlor + clopyralid + flumetsulam	15 + 4 2	Corteva	—	warning	12 hr <sup>e</sup>
Surpass NXT	6.4EC	acetochlor + safener	15 + —	Corteva	—	warning	12 hr <sup>e</sup>
Surveil	12 + 36	cloransulam + flumioxazin	2 + 14	Corteva	—	caution	12 hr
Synchrony XP	21.5 + 6.9DF	chlorimuron+ thifensulfuron	2 + 2	Corteva	—	caution	12 hr
Talinor	1.46 + 0.31EC	bromoxynil + bicyclopyrone	6 + 27	Syngenta	—	caution	24 hr
Tavium	1.12 + 2.26 CS	dicamba + S-metolachlor	4 + 15	Syngenta	yes	caution	24 hr
Tendovo	3.47 + 0.065 + 0.642 ZC	S-metolachlor + cloransulam + metribuzin	15 + 2 + 5	Syngenta	—	caution	12 hr
Treflan	4EC, 10G	trifluralin	3	Gowan	—	caution	12 hr <sup>e</sup>
Tripleflex II	3.75+ 0.38+ 0.12L	acetochlor + clopyralid + flumetsulam	15 + 4 + 2	Bayer	—	warning	12 hr <sup>e</sup>
Trivence	61.3DG	chlorimuron + flumioxazin + metribuzin	2 + 14 + 5	Corteva	—	caution	12 hr
TriVolt	0.23 + 0.57 + 2.85SC	thiencarbazone + isoxaflutole + flufenacet	2 + 27 + 15	Bayer	yes	caution	23 d
Ultra Blazer	2S	acifluorfen	14	UPL	—	danger	48 hr
Valor EZ	4L	flumioxazin	14	Valent	—	caution	12 hr
Valor SX	51DF	flumioxazin	14	Valent	—	caution	12 hr
Valor XLT	30 + 10.3DF	flumioxazin + chlorimuron	14 + 2	Valent	—	caution	12 hr
Velpar	75DF, 2S	hexazinone	5	NovaSource	—	danger	24 hr
Verdict	0.57 + 5EC	saflufenacil + dimethenamid-P	14 + 15	BASF	—	warning	12 hr
Vida	0.208EC	pyraflufen	14	Gowan	—	danger	12 hr
Warrant	3CS	acetochlor	15	Bayer	—	caution	12 hr
Warrant Ultra	2.8 + 0.6 L	acetochlor + fomesafen	15 + 14	Bayer	—	caution	12 hr
Weedmaster	2.87 + 1S	2,4-D amine + dicamba	4 + 4	Nufarm	—	danger	48 hr
Wolverine Advanced	0.4 + 0.13 + 1.5 L	fenoxaprop + pyroxasulfotole + bromoxynil	1 + 27 + 6	Bayer	—	danger	24 hr
Xtendimax	2.9 SL	dicamba (DGA salt)	4	Bayer	yes	caution	24 hr
Yukon	12.5 + 50DF	halosulfuron + dicamba	2 + 4	Gowan	—	caution	12 hr
Zidua	85 DF	pyroxasulfone	15	BASF	—	caution	12 hr
Zidua SC	4.17 SC	pyroxasulfone	15	BASF	—	caution	12 hr
Zidua PRO	2.28 + 1.33 + 0.48 SC	pyroxasulfone + imazethapyr + saflufenacil	15 + 2 + 14	BASF	—	caution	12 hr

See endnotes following table 8-3

**Table 7-2.** Insecticide products and related information

Commercial name	Formulation <sup>a,b</sup>	Active ingredient(s)	Manufacturer	RUP <sup>a</sup>	Signal word	REI <sup>d</sup>
Acephate 90 Prill	90% prill	acephate	ADAMA	—	caution	24 hr
Actellic <sup>c</sup>	5EC	pirimiphos-methyl	Winfield	—	danger	—
Adjourn	SC	deltamethrin	Atticus	—	caution	—
Alias	4F	imidacloprid	ADAMA	—	caution	12 hr
Ambush I	2EC	permethrin	Amvac	yes	warning	12 hr
Asana XL	0.66EC	esfenvalerate	Valent	yes	warning	12 hr
Avicta Complete Corn	FS	abamectin + thiamethoxam	Syngenta	yes	warning	48 hr <sup>e</sup>
Aztec 2.1G	2.1G	tebupiriphos + cyfluthrin	Amvac, Bayer	yes	warning	48 hr <sup>e</sup>
Aztec 4.67G	4.67G	tebupiriphos + cyfluthrin	Amvac, Bayer	yes	warning	48 hr
Aztec HC	8.9G	tebupiriphos, cyfluthrin	Amvac	yes	warning	48 hr
<i>Bacillus thuringiensis</i>	several	<i>Bacillus thuringiensis</i>	Several	—	caution	4 hr
Baythroid XL	1EC	beta-cyfluthrin	Bayer	yes	warning	12 hr
Belay	2.13SC	clothianidin	Valent	—	caution	12 hr
Belt 4SC	4SC	flubendiamide	Bayer	—	caution	12 hr
Besiege	0.835 + 0.417 SC	chlorantraniliprole + lambda-cyhalothrin	Syngenta	yes	warning	24 hr
Bifenture LFC	1.5 LFC	bifenthrin	UPI	yes	warning	12 hr
Biobit	58.2 WP	<i>Bacillus thuringiensis</i>	Valent		caution	4 hr
Brigade 2EC	2EC	bifenthrin	FMC	yes	warning	12 hr
Capture LFR	1.5LFR	bifenthrin	FMC	yes	warning	12 hr
Capture 3Rive 3D	1.6 L	bifenthrin	FMC	yes	caution	12 hr
Centynal EC	4.75 EC	deltamethrin	Central Garden & Pet Company	—	caution	—
Centynal Synergized Insecticide	1.2 + 33.3 EC	deltamethrin + piperonyl butoxide	Central Garden & Pet Company	—	caution	—
Cobalt	2.5 lb + 0.045 lb	chlorpyrifos + gamma-cyhalothrin	Corteva	yes	danger	24 hr
Cobalt Advanced	2.5 + 0.129EC	chlorpyrifos + lambda-cyhalothrin	Corteva	yes	warning	24 hr
Comite 6.55EC	6.55EC	propargite	Chemtura	yes	danger	13 days
Coragen 1.67SC	1.67SC	chlorantraniliprole	DuPont		caution	4 hr
Counter 20G Lock'n Load <sup>h</sup>	20G	terbufos	Amvac	yes	danger	48 hr <sup>e</sup>
Counter 20G SmartBox <sup>h</sup>	20G	terbufos	Amvac	yes	danger	48 hr <sup>e</sup>
Cruiser 5FS	5FS	thiamethoxam	Syngenta	—	caution	12 hr <sup>e</sup>
Cruiser Maxx Cereals	1 gallon contains 0.26 lbs ai of thiamethoxam	thiamethoxam	Syngenta	—	caution	48 hr
Cruiser Vibrance Quattro	1 gallon contains 0.51 lbs ai of thiamethoxam	thiamethoxam	Syngenta	—	caution	48 hr
Deadline M-Ps	4% bait	metaldehyde	AMVAC	—	caution	12 hr
Declare 1.25CS	1.25CS	gamma-cyhalothrin	Cheminova	yes	caution	24 hr
Delta Gold 1.5EC	1.5EC	deltamethrin	Winfield	yes	danger	12 hr
DEsect	85D	diatomaceous earth	EP Naturals	—	caution	—

See endnotes following table 7-3

Continued on next page

**Table 7-2.** Insecticide products and related information (continued)

Commercial name	Formulation <sup>a,b</sup>	Active ingredient(s)	Manufacturer	RUP <sup>a</sup>	Signal word	REI <sup>d</sup>
Diacon D	0.8 D	methoprene	Wellmark	—	caution	—
Diacon IGR	33.6 EC	methoprene	Wellmark	—	caution	—
Diacon IGR PLUS	4.75 + 11.40 EC	deltamethrin + methoprene	Wellmark	—	warning	—
Dimethoate (several)	several	dimethoate	several	—	warning	48 hr
Dipel	54% DF	<i>Bacillus thuringiensis</i>	Valent	—	caution	4 hr
Dryacide 100	100 D	diatomaceous earth	Winfield	—	caution	—
Elevest	EC	bifenthrin + chlorantraniliprole	FMC	yes	caution	12 hr
Endio ZCX	1.8 + 0.9ZC	thiamethoxam + lambda-cyhalothrin	Syngenta	yes	warning	24 hr
Ethos Elite LFR	1.5 LFR (bifenthrin) + 0.48 <i>Bacillus</i> strains	bifenthrin + <i>Bacillus velezensis</i> strain RTI301 + <i>Bacillus subtilis</i> strain RTI477	FMC	—	warning	—
Ethos XB	1.5 LFR (bifenthrin)	bifenthrin + <i>Bacillus amyloliquifaciens</i> strain D747	FMC	yes	caution	12 hr
Evergreen	5 SC	pyrethrins	MGK	—	caution	12 hr
EverGreen 60+6	6 EC	pyrethrins + piperonyl butoxide	Valent	—	caution	—
Fanfare	EC & ES	bifenthrin	ADAMA	yes	warning	12 hr
Fastac EC	0.83EC	alpha-cypermethrin	BASF	yes	danger	12 hr
Fastac SC	0.83SC	alpha-cypermethrin	BASF	yes	caution	12 hr
Force 3G	3G	tefluthrin	Amvac, Syngenta	yes	caution	48 hr
Force Evo	2.1 EC	tefluthrin	Syngenta	yes	danger	48 hr
Gaucho 600	5F	imidacloprid	Bayer	—	caution	12 hr <sup>e</sup>
Gravista	1.2 + 33.3 + 2.85 EC	deltamethrin + piperonyl butoxide + s-methoprene	Central Garden + Pet Company	—	warning	—
Hero	1.24EC	zeta-cypermethrin + bifenthrin	FMC		caution	12 hr
Imidan 70W	70W	phosmet	Gowan	—	warning	24 hr
Intrepid 2F	2F	methoxyfenozide	Corteva	—	caution	4 hr
Intrepid Edge		methoxyfenozide spinetoram	Corteva	—	caution	4 hr
Javelin WG	185 WDG	<i>Bacillus thuringiensis</i>	Certis	—	caution	4 hr
Kernel Guard Supreme	dry planter box seed treatment	permethrin	Chemtura	—	caution	12 hr <sup>e</sup>
Lannate LV	2.4LV	methomyl	Corteva	yes	danger	48 hr
Lannate SP	90SP	methomyl	Corteva	yes	danger	48 hr
Leverage 360	2.7SE	imidacloprid + cyfluthrin	Bayer	yes	warning	12 hr
Lorsban 4E	4 EC	chlorpyrifos	Corteva	yes	warning	24 hr
Lorsban 15G <sup>h</sup>	15G	chlorpyrifos	Corteva		caution	24 hr <sup>e</sup>
Lorsban Advanced <sup>h</sup>	3.75SE	chlorpyrifos	Corteva	yes	warning	24 hr <sup>e</sup>
Majestene	1500 BAWKU/mg	heat-killed <i>Burkholderia</i> spp.	Marrone	—	caution	4 hr
Malathion	several	malathion	Several	—	caution, warning (see label)	12 hr

See endnotes following table 7-3

Continued on next page

**Table 7-2.** Insecticide products and related information (continued)

Commercial name	Formulation <sup>a,b</sup>	Active ingredient(s)	Manufacturer	RUP <sup>a</sup>	Signal word	REI <sup>d</sup>
Metaldehyde bait (several)	pellets	metaldehyde	Several	—	caution	12 hr
Mustang	1.5 EC	zeta-cypermethrin	FMC	yes	warning	12 hr
Mustang Maxx	0.8EC	zeta-cypermethrin	FMC	yes	warning	12 hr
NipsIt INSIDE	5FS	clothianidin	Valent	—	caution	— <sup>e</sup>
NipsIt SUITE Cereals	0.256 + 0.077 + 0.038FS	clothianidin + metalaxyl + metconazole	Valent	—	caution	—
NyGuard IGR Concentrate	10 EC	pyriproxyfen	MGK	—	caution	—
Oberon 2SC	2SC	spiromesifen	Bayer	—	caution	12 hr
Oberon 4SC	4SC	spiromesifen	Bayer	—	caution	12 hr
Paradigm	1EC	lambda-cyhalothrin	ADAMA	yes	caution	
Prevathon	5SC	chlorantraniliprole	Corteva	—	—	4 hr
Poncho 600	5FS	clothianidin	Bayer	—	caution	— <sup>e</sup>
Poncho VOTiVo	4.17 + 0.84FS	clothianidin + <i>Bacillus firmus</i>	Bayer	—	caution	— <sup>e</sup>
Pyclear	3 + 30 EC	pyrethrins + piperonyl butoxide	Biosafe	—	warning	—
Pyronyl Crop Spray	6 + 60 EC	pyrethrins + piperonyl butoxide	Zoecon	—	caution	12 hr
Renestra	0.47 0.17	alpha-cypermethrin afidopyropen	BASF	yes	warning	12 hr
Sefina	0.41 lb ai/gal	afidopyropen	BASF	—	caution	12 hr
Sensat	8.66 EC	spinosad	Envu	—	caution	—
Sevin XLR Plus	4F	carbaryl	Bayer	—	caution	12 hr
Silencer	1EC	lambda-cyhalothrin	ADAMA	yes	warning	24 hr
SkyRaider	SC	bifenthrin, imidacloprid	ADAMA	yes	warning	12 hr
SmartChoice 5G	5G	chlorethoxyfos + bifenthrin	Amvac	yes	danger	48 hr
Sniper	2.0 EC	bifenthrin	Loveland	yes	warning	12 hr
Stewart EC	1.25 EC	indoxacarb	FMC	—	caution	12 hr
SureKill Evolve	4.75 SC	deltamethrin	Neogen	—	caution	—
Suspend SC	4.75 SC	deltamethrin	Envu	—	caution	—
Suspend Polyzone	4.75 SC	deltamethrin	Envu	—	caution	—
Tempo SC Ultra <sup>9</sup>	11.8 SC	beta-cyfluthrin	Envu	—	caution	—
Tracer	4L	spinosad	Corteva	—	caution	4 hr
Transform WG	50 WG	Sulfoxaflor	Corteva	—	danger	24 hr
Tundra Supreme	2.5 lb of chlorpyrifos 0.76 lbs of bifenthrin	chlorpyrifos bifenthrin	WinField Agrisolutions	yes	warning	24 hr
Vantacor	5.0	chlorantraniliprole	FMC	yes	—	4 hr
Vulcan	3.76EC	chlorpyrifos	ADAMA	yes	caution	24 hr
Warhawk	4.0 lb gallon	chlorpyrifos	Loveland	yes	warning	24 hr
Warrior II	2.08CS	lambda-cyhalothrin	Syngenta	yes	warning	24 hr
Zeal	2.88 SC	etoxazole	Valent	—	caution	12 hr
Zeposector-SII	0.15 + 1.5 RTU	pyrethrins + piperonyl butoxide	Zep-Inc	—	caution	—

See endnotes following table 7-3

**Table 7-3.** Fungicide products and related information

Commercial name	Formulation <sup>a,b</sup>	Active ingredient(s)	Manufacturer	Signal word	REI <sup>d</sup>
Absolute 500 SC	22.63%+22.63%	tebuconazole+trifloxystrobin	Bayer	caution	12 hr
Acceleron DX-109	18.4%	pyraclostrobin	Monsanto	caution	12 hr
Actinogrow ST	0.33%	<i>Streptomyces lydicus</i>	SimcamAdvan	caution	1 hr
Adastrio	15.7+10.5%+15.7%	azoxystrobin+fluidinpyr +flutriafol	FMC	caution	12 hr
Affiance	7.48%+9.35%	tetraconazole+azoxystrobin	Gowan	caution	12 hr
AfterShock	40.30%	fluoazastobin	Loveland Products	caution	12 hr
Allegiance Dry	12.5%	metalaxyl	Chemtura	caution	24 hr
Allegiance FL	2.6 FL	metalaxyl	Bayer Crop Science	warning	24 hrw
Alto	100 SL	cyproconazole	Syngenta	caution	12 hr
AmTide Propiconazole	41.80%	propiconazole	AmTide	caution	12 hr
Aproach	22.50%	picoxystrobin	DuPont	caution	12 hr
Aproach Prima	17.94% +7.17%	picoxystrobin+cyproconazole	DuPont	caution	12 hr
Apron Maxx RFC	2.31%+3.46%	fludioxonil+mefenoxam	Syngenta	caution	48 hr
Apron Maxx RTA	0.73% +0.73%	fludioxonil +mefenoxam	Syngenta	caution	48 hr
Apron Maxx RTA +Moly	1.02%+0.68%	mefenoxam+fludioxonil	Syngenta	caution	48 hr
Apron XL	33.30%	mefenoxam	Syngenta	warning	48 hr
Apron XL LS	3.3S	mefenoxam	Syngenta	warning	48 hr <sup>e</sup>
Avaris	7%+11.7%	azoxystrobin+propiconazole	Helena Chemical	warning	12 hr
Avicta Duo Corn	12.4%+28.1%	abametin+thiamethoxam	Syngenta	warning	4 hr
Bean Guard/Alliance	12.5%+3.75%+24.45%	carboxin+metalaxyl+captan	Chemtura	danger	24 hr
Bravo Weather Stik	6F	chlorothalonil	Syngenta	caution	12 hr
Bumper	41.8EC	propiconazole	Makhteshim-Agan	warning	24 hr
Bumper ES	40.85%	propiconazole	Makhteshim-Agan	caution	12 hr
Captan	5D, 7.5D, 80WP	captan	several	danger	4 days <sup>ij</sup>
Caramba	0.75EC	metconazole	BASF	warning	12 hr
Cercobin	4.11SC	thiophanate-methyl	FMC	caution	12 hr
CruiserMaxx Advanced	21.50%+3.21% +1.07%	thiamethoxam+mefenoxam +fludioxonil	Syngenta	caution	48 hr
Cuprofix MZ Disperss	30+22DF	mancozeb+copper sulfate	Cerexagri	caution	24 hr
Cuprofix Ultra	40DF	copper sulfate	Cerexagri	caution	12 hr
Custodia	11%+18.35%	azoxystrobin+tebuconazole	ADAMA	warning	12 hr
Delaro	16.0% +13.7% SC	prothioconazole+trifloxystrobin	Bayer	caution	12 hr
Delaro Complete	14.9% +13.1% + 10.9% SC	prothioconazole+trifloxystrobin +fluopyram	Bayer	caution	12 hr
Dithane	75DF, 45F, 45ME	mancozeb	Dow	caution	24 hr
Dividend	0.15S, 0.31S	difenoconazole	Syngenta	caution	12 hr <sup>e</sup>
Domark 230ME	1.9EW	tetraconazole	Isagro	caution	24 hr
Dyna-Shield Metalaxyl	28.35%	metalaxyl	Loveland Products	warning	24 hr
Dynasty	9.6%	axoxystrobin	Syngenta	caution	4 hr
Echo	90DF	chlorothalonil	Sipcam Agro USA	danger	12 hr

See endnotes following table

Continued on next page

**Table 7-3.** Fungicide products and related information (continued)

Commercial name	Formulation <sup>a,b</sup>	Active ingredient(s)	Manufacturer	Signal word	REI <sup>d</sup>
Echo Zn	4.17F	chlorothalonil	Sipcam Agro USA	warning	12 hr
Echo 720	6F	chlorothalonil	Sipcam Agro USA	warning	12 hr
Endura	70%	boscalid	BASF	warning	12 hr
Enhance	20 +20D	carboxin+captan	Trace Chemicals	danger	48 hr <sup>e</sup>
Equation	2.08SC	azoxystrobin	Cheminova	caution	4 hr
Equus DF	82.5%	chlorothalonil	ADAMA	warning	12 hr
Equus 720 SST	54%	chlorothalonil	ADAMA	warning	12 hr
Evergol Energy	16.51%	prothioconazole +penflufen +metalaxyl	Bayer	caution	24 hr
Evergol Energy SB	16.51%	prothioconazole +penflufen +metalaxyl	Bayer	caution	24 hr
Evito 480 SC	40.30%	fluoxastrobins	Arysta LifeScience	caution	12 hr
Evito T	18.0% +25%	fluoxastrobins+tebuconazole	Arysta LifeScience	warning	Various
Fitness	41.80%	propiconazole	Loveland Products	warning	12 hr
Folicur	3.6F	tebuconazole	Bayer	caution	12 hr
Fontelis	20.40%	penthiopyrad	DuPont	caution	12 hr
Fortix	3.22 SC	fluoxastrobins+flutriafol	Arysta LifeScience	caution	12 hr
Headline	2.09EC	pyraclostrobin	BASF	warning	12 hr
Headline AMP	13.64%+5.14%	pyraclostrobin+metconazole	BASF	warning	12 hr
Heads up	61.3%	extract of <i>Chenopodium quinoa</i> saponins	Heads up Plant Protectants	caution	12 hr
Incognito 4.5F	46.2%	thiophanate-methyl	ADAMA	caution	24 hr
Incognito 85WDG	85%	thiophanate-methyl	ADAMA	caution	24 hr
ILevo	48.4%	fluopyram	Bayer	caution	24 hr
Intego Suite Soybeans	20.6% +2.97% +0.99% +0.79%	clothianidin+ethaboxam +ipconazole+metalaxyl	Valent	caution	24 hr
Kocide 2000	53.80%	copper hydroxide	DuPont	warning	48 hr
Kocide 3000	46.1DF	copper hydroxide	DuPont	caution	24 hr
Koverall	75DF	mancozeb	FMC	caution	24 hr
Laredo	2EC	myclobutanil	Dow	danger	24 hr
Manzate	4F	mancozeb	DuPont	caution	24 hr
Manzate Flowable	37 F	mancozeb	DuPont	caution	24 hr
Manzate Max	37%	mancozeb	United Phosphorus	caution	24 hr
Manzate Pro-Stick	75DF	mancozeb	DuPont	caution	24 hr
Maxim <sup>l</sup>	4S	fludioxonil	Syngenta	caution	—
Maxim Quattro	3.32%+2.65% +1.33%+26.50%	fludioxonil+mefenoxam +azoxystrobin+thabendazole	Syngenta	caution	—
Mertect 340	4.1F	thiabendazole	Syngenta	danger	12 hr
Mertect 340-F	42.3%	thiabendazole	Syngenta	caution	12 hr
MetaStar ST	29.99%	metalaxyl	LG Life Sciences	warning	24 hr
Miravis Ace	2.3 SE	pydiflumetofen+propiconazole	Syngenta	caution	12 hr

See endnotes following table

Continued on next page

**Table 7-3.** Fungicide products and related information (continued)

Commercial name	Formulation <sup>a,b</sup>	Active ingredient(s)	Manufacturer	Signal word	REI <sup>d</sup>
Miravis Neo	2.5 SE	pydiflumetofen+azoxystrobin +propiconazole	Syngenta	warning	12 hr
Muscle 3.6F	38.70%	tebuconazole	Sipcam Agro	caution	12 hr
Nexicor	2.81%+18.76%+11.73%	propiconazole+fluxapyroxad +pyraclostrobin	BASF	caution	12 hr
NipsIt SUITE	2.93%+0.88% +0.44%	clothianidin+metalaxyl +metconazole	Valent	caution	24 hr
Omega	4.17F	fluazinam	Syngenta	warning	12 hr
Onset <sup>k</sup>	38.70%	tebuconazole	WinField	caution	12 hr
Orius 3.6F <sup>k</sup>	38.70%	tebuconazole	ADAMA	caution	12 hr
Oxidate 2.0	27.1% +2.0%	hydrogen dioxide +peroxyacetic acid	BioSafe Systems	danger	1 hr
Penncozeb	75DF	mancozeb	United Phosphorus	caution	24 hr
Preemptor	3.22 SC	fluoxastrobin +flutriafol	FMC	caution	12 hr
Priaxor	14.33%+28.58%	fluxapyroxad+pyraclostrobin	BASF	caution	12 hr
Pristine	12.8% +25.2%	pyraclostrobin +boscalid	BASF	caution	12 hr
Proline 480	45C	prothioconazole	Bayer	caution	48 hr
Propicure 3.6F	41.80%	propiconazole	Direct Ag Source	warning	12 hr
PropiMax	3.6EC	propiconazole	Dow	warning	24 hr <sup>e</sup>
Propulse	3.34 SC	fluopyram+prothioconazole	Bayer	caution	12 hr
Prosaro	421 SC	prothioconazole+tebuconazole	Bayer	caution	48 hr
Prosaro Pro	400 SC	Prothioconazole+tebuconazole +fluopyram	Bayer	caution	12 hr
Quadris	2F	azoxystrobin	Syngenta	caution	4 hr
Quadris Ridomil Gold <sup>m</sup>	2F+4EC	azoxystrobin+mefenoxam	Syngenta	caution	48 hr <sup>e</sup>
Quadris Top	18.2% +11.4%	azoxystrobin +difenoconazole	Syngenta	caution	12 hr
Quadris Xtra	280 SC	azoxystrobin+cyproconazole	Syngenta	caution	12 hr
Quilt	1.04 +0.62EC	azoxystrobin+propiconazole	Syngenta	warning	12 hr
Quilt Xcel	1.2L+1.18L	azoxystrobin+propiconazole	Syngenta	warning	12 hr
Rancona Xxtra	0.0916%+1.64 %	ipconazole+metalaxyl	Chemtura	caution	24 hr
Raxil Pro MD	2.44%	prothioconazole +tebuconazole +metalaxyl	Bayer	danger	24 hr
Raxil XT	15 +20WP	tebuconazole+metalaxyl	Bayer	caution	24 hr <sup>e</sup>
Revytek	11.61% +15.49% +7.74%	mefentrifluconazole +pyraclostrobin+fluxapyroxad	BASF	warning	12 hr
Ridomil Gold GR	2.5G	mefenoxam	Syngenta	caution	48 hr <sup>e</sup>
Rizolex	42.00%	tolclofos-methyl	Valent	caution	12 hr
Saltro	41.7%	pydiflumetofen	Syngenta	caution	4 hr
Sphaerex	10.9% +18.2%	metconazole+prothioconazole	BASF	warning	12 hr
Stamina	18.40%	pyraclostrobin	BASF	caution	12 hr

See endnotes following table

**Table 7-3.** Fungicide products and related information (continued)

Commercial name	Formulation <sup>a,b</sup>	Active ingredient(s)	Manufacturer	Signal word	REI <sup>d</sup>
Stratego	1.04+1.04S	propiconazole+trifloxystrobin	Bayer Crop Science	warning	24 hr
Stratego YLD	1.05LS+3.13LS	prothioconazole+triflozystrobin	Bayer Crop Science	caution	48 hr
T-22 HC	1.15%	<i>Trichoderma harzianum</i>	BioWorks	caution	—
TebuStar 3.6L <sup>k</sup>	38.70%	tebuconazole	Agri Star	caution	12 hr
Tebuzol <sup>k</sup>	38.70%	tebuconazole	United Phosphorus	caution	12 hr
Thiram	65WP	thiram	Taminco	caution	24 hr
Tilt	3.6EC	propiconazole	Syngenta	warning	24 hr <sup>e</sup>
Topaz	41.80%	propiconazole	WinField	warning	12 hr
Topguard	1.04 SC	flutriafol	FMC	caution	12 hr
Topguard EQ	25.3% +18.6% SC	azoxystrobin+flutriafol	FMC	caution	12 hr
Topsin M	4.5F +70WP	thiophanate+methyl	Cerexagri	caution	12 hr
Trilex	22.0%	trifloxystrobin	Bayer Crop Science	caution	12 hr
Trivapro	2.9%+10.5%+11.9%	benzovindiflupyr+azoxystrobin+propiconazole	Syngenta	warning	12 hr
Twinline	1.083L +0.67L	pyraclostrobin+metconazole	BASF	warning	12 hr
Veltyma	17.56% +17.56%	mefentrifluconazole+pyraclostrobin	BASF	warning	12 hr
Vertisan	20.60%	penthiopyrad	DuPont	warning	12 hr
Viathon	49.0% +3.3%	potassium phosphite+tebuconazole	Helena	caution	12 hr
Vibrance	45.45%	sedaxane	Syngenta	caution	12 hr
Xyway	20.9%	flutriafol	FMC	caution	12 hr
Zeltera	34.1 %	lnpyrfluxam	Valent	caution	12 hr

See endnotes following table

#### Endnotes for Appendix Tables 7-1, 7-2, 7-3

<sup>a</sup> CS = capsule suspension; D = dust; DF = dry flowable; DS = dry soluble; E = emulsifiable; EC = emulsifiable concentrate; ES = emulsifiable suspension; EW = emulsifiable in water; F = flowable; FL = flowable liquid; FS = insecticidal seed treatment specifically formulated for use by commercial seed treatment companies only; G = granular, L = liquid flowable; LFR = liquid fertilizer ready; LS = liquid sprayable; LV = liquid volatile; ME = microencapsulated; REI = restricted-entry interval; RUP = restricted-use product; S = soluble; SC = suspension concentrate; SE = suspension emulsion; SG = soluble granules; SP = soluble powder; WG = wettable granules; WP = wettable powder; WSP = water-soluble packet; ZC = Zeon Concentrate

<sup>b</sup> Numbers before the dry formulations (D, G, WP, etc.) represent percent active ingredient; numbers before liquid formulations (EC, E, SP, F, etc.) represent pounds of active ingredient or ae/gal of product.

<sup>c</sup> Weed Science Society of America (WSSA)-approved group numbers for the corresponding herbicide site of action (SOA).

<sup>d</sup> REI as required by the Worker Protection Standard (WPS) to protect agricultural workers and handlers of agricultural pesticides. Labeled nonagricultural uses may have different REIs or worker notification requirements.

<sup>e</sup> REI exception: If the product is soil-injected or soil-incorporated or used for seed treatment, the WPS, under certain circumstances, allows workers to enter the treated area if there will be no contact with anything that has been treated.

<sup>f</sup> Under the WPS, this is a nonagricultural use product, thus there is no REI requirement.

<sup>g</sup> REI exception: 24 hours for harvest aid and desiccation applications.

<sup>h</sup> Under the WPS, this product requires dual notification to workers: verbal AND posted. Wisconsin has additional posting requirements when this product is applied to areas within 300 feet of a residence, migrant labor camp, school, day care facility, health care facility, commercial or industrial facility, public recreation area, or other nonagricultural area where people are likely to be present during the REI.

<sup>i</sup> REI exception: After the first 48 hours of the REI, workers may enter the treated area to perform hand labor or other tasks involving contact with anything that has been treated, such as plants, soil, or water, without time limit, if they wear the early-entry personal protective equipment (PPE) listed on the label.

<sup>j</sup> REI exception: 24 hours for strawberries. After expiration of the 24-hour period, no PPE is required.

<sup>k</sup> REI Exception: 19 days for sweet corn.

<sup>l</sup> For use only by commercial seed treaters.

<sup>m</sup> Sold in two containers (co-packs).

**Table 7-4.** Planting interval for rotational crops

Herbicide	Alfalfa <sup>a</sup>	Barley	Snap beans	Field corn	Sweet corn	Oats	Peas	Potato	Soybean	Tobacco	Wheat	Comments
2,4-D Amine 4, Shredder	30D	0-30D	30D	7-14D	7-14D	0-30D	30D	30D	15-30D	30D	0-30D	Varies by companies; see label for details on specific restrictions
2,4-D LV4, Shredder	30D	0-30D	30D	7-14D	7-14D	0-30D	30D	30D	7-15D	30D	0-30D	Varies by companies; see label for details on specific restrictions
Aatrex	2Y	2Y	2Y	0	0	2Y	2Y	2Y	FY	2Y	2Y	
Accent Q	10M	8M	10M	0	10M	8M	10M	10M	15D	10M	4-8M	<b>Sweet corn:</b> Hybrids Merit, Carnival, and Sweet Success require 15M <b>Potato and tobacco:</b> 18M if soil pH greater than 6 <b>Wheat:</b> Use shorter interval for winter wheat, longer interval for spring wheat
Acuron	18M	4M	18M	0	0	18M	18M	10M	10M	18M	4M	
Acuron Flexi	10M	4M	18M	0	0	18M	18M	10M	10M	18M	4M	If applied after June 1, rotating to crops with 10 month intervals other than corn may result in crop injury
Affinity BroadSpec	45D	0	45D	14D	45D	45D	45D	45D	7D	45D	0	
Afforia	4-10M	3-4M	4-6M	14-30D	3-4M	4-10M	3-4M	4-12M	1-7D	45-60D	30D	Use shorter interval if 2.5 oz or less is used; otherwise use longer interval <b>Field corn and soybean:</b> Add 7 days on light-textured soils or soils with a pH greater than 7.9
Anthem	10M	11-18M	18M	0	0	11-18M	11M	4M	0-4M	18M	4-6M	
Anthem Flex	10M	11-18M	11M	0	0	11-18M	11M	4M	0-4M	18M	0-6M	See label for detailed descriptions on interval when ranges are present (based on rate applied)
Anthem Maxx	10M	11-18M	18M	0	0	11-18M	11M	4M	0-4M	18M	4-6M	See label for detailed descriptions on interval when ranges are present (based on rate applied)
Anthem ATZ	18M	18M	18M	0	0	18M	18M	18M	FY	18M	18M	
Assure II	4M	4M	0	4M	4M	4M	0	4M	0	4M	4M	
Authority Assist	12M	9.5M	10M	10M	10-18M	18M	10M	26M	0	9.5M	4M	
Authority Elite	12M	4.5M	12M+BA	10M	18M	12M	12M+BA	4M	0	10M	4.5M	<b>Alfalfa:</b> To avoid injury do not apply more than 1.9 lb ai metolachlor per acre in previous crop or make lay-by or other post applications

Abbreviations: 0 = no restriction; M = month; AH = after harvest; D = day; Y = year; NA = not approved; NL = not listed; BA = bioassay required; FY = following year; — = no restrictions for rotational crops listed on label

<sup>a</sup> See the label for information on crops not listed below

Continued on next page

**Table 7-4.** Planting interval for rotational crops (continued)

Herbicide	Alfalfa <sup>a</sup>	Barley	Snap beans	Field corn	Sweet corn	Oats	Peas	Potato	Soybean	Tobacco	Wheat	Comments
Authority First	12M	12M	12M	10–18M	10–18M	12M	9M	18M	0	30M	4M	<b>Field corn:</b> 18M if pH greater than 7 and organic matter is less than 1.5%
Authority Maxx	12–18M	4M	36M	10–18M	18M	12–18M	36M	36M	0	10–18M	4M	
Authority MTZ	12M	4M	18M	4–10M	18M	18M	18M	12M	0	12M	4M	
Autumn Super 51 WDG	18M	9M	18M	30D	9M	18M	18M	18M	60D	18M	3M	Crops with 18M interval require 30 inches of rainfall; 24M if soil pH greater than 7.5 <b>Barley and sweet corn:</b> 18M if soil pH greater than 7.5; minimum rainfall of 15 inches required <b>Soybean:</b> 9M if soil pH greater than 7.5; 4M for sulfonyl-tolerant soybean (STS) varieties
Balance Flexx	10M	6M	18M	0	6M	18M	18M	6M	6M	18M	4M	
Banvel	AH	AH	AH	0	AH	AH	AH	AH	AH	AH	AH	Use shorter interval after 8 oz/a and longer interval after 16 oz/a
Basagran	—	—	—	—	—	—	—	—	—	—	—	
Basis Blend	10M	9M	10M	0	10M	9M	10M	1M	10M	10M	3–9M	<b>Soybean:</b> Intervals are for 1.25 oz/a rate without Optimum GAT or STS soybean. Lesser soybean rotations restrictions may apply; see label <b>Wheat:</b> Use shorter interval for winter wheat, longer interval for spring wheat
Bicep Lite II	2Y	2Y	2Y	0	0	2Y	2Y	2Y	FY	2Y	2Y	If applied after June 10th, do not rotate with crop other than corn or sorghum the next year, or crop injury may occur
Boundary 6.5	4.5M	8M	12M	8M	8M	12M	8M	0	0	12M	4.5–8M	<b>Wheat:</b> Use shorter interval for winter wheat, longer interval for spring wheat
Broadaxe XC	12M	4.5M	BA	10M	18M	12M	12M	4M	0	10M	4.5M	
Brox 2EC	30D	30D	30D	0	30D	30D	30D	30D	30D	30D	30D	
Bullet/Lariat	FY	2Y	2Y	0	0	2Y	2Y	2Y	FY	2Y	2Y	
Butyrac 200	—	—	—	—	—	—	—	—	—	—	—	
Cadet	AH	AH	AH	0	0	AH	AH	AH	0	AH	AH	
Callisto	10M	4M	18M	0	0	0	18M	10M	10M	10M	4M	

Abbreviations: 0 = no restriction; M = month; AH = after harvest; D = day; Y = year; NA = not approved; NL = not listed; BA = bioassay required; FY = following year; — = no restrictions for rotational crops listed on label  
<sup>a</sup> See the label for information on crops not listed below

Continued on next page

Principles of pest management

Corn weeds

Soybean

Forages & pastures

Small grains

Stored grain insects

Appendix

**Table 7-4.** Planting interval for rotational crops (continued)

Herbicide	Alfalfa <sup>a</sup>	Barley	Snap beans	Field corn	Sweet corn	Oats	Peas	Potato	Soybean	Tobacco	Wheat	Comments
Callisto GT	10M	4M	18M	0	0	4M	18M	10M	10M	10M	4M	
Callisto Xtra	FY	FY	18M	0	0	18M	18M	FY	FY	18M	FY	
Canopy Blend	10M	4M	12M	10M	18M	30M	12M	30M	0	10M	4M	
Canopy EX	12M	3M	9M	9M	18M	3M	9M	30M	0	9M	3M	
Capreno	18M	10M	18M	0	10M	10M	18M	18M	10M	12M	4M	<b>Sweet corn:</b> 11M if soil pH greater than 7.5
Chaparral	24M	12M	24M	12M	12M	12M	24M	24M	24M	24M	12M	<b>Alfalfa, snap beans, peas, potato, soybean, and tobacco:</b> Bioassay required
Chateau	6–12M	6–12M	6–18M	4M	6–12M	6–12M	6–18M	6–12M	4M	4M	4M	Intervals are for 4 oz/a rate; use 6M interval if soil tilled before planting
Cimarron Max/Plus	BA	BA	BA	BA	BA	10M	BA	BA	BA	BA	1M	Intervals are for 0.25 oz/a rate
Cimarron X-tra	BA	24M	BA	BA	BA	16M	BA	BA	BA	BA	4M	Intervals are for 0.5 oz/a rate
Clarity	4M	15–30D	4M	0	4M	15–30D	4M	4M	14–28D	4M	15–30D	
Classic	9M	3M	9M	9M	9M	3M	9M	30M	0	15M	3M	
Cobra/Phoenix	—	—	—	—	—	—	—	—	—	—	—	
Corvus	17M	9M	17M	0	9M	17M	17M	17M	9M	17M	4M	
Degree Xtra	2Y	2Y	2Y	0	0	2Y	2Y	2Y	FY	2Y	2Y	
Diflexx	120D	60D	130D	0	120D	120D	120D	120D	30–60D	120D	120D	<b>Soybean:</b> If 12 fl oz/a or less 30 days otherwise 60 days
Diflexx Duo	18M	10M	18M	0	10M	10M	18M	18M	10M	12M	4M	
Dual II Magnum	4M	4.5M	0	0	0	4.5M	0	0	0	FY	4.5M	
Enlist Duo	30D	30D	30D	7–14D	7–14D	30D	30D	30D	15–30D	30D	30D	
Enlist One	30D	30D	30D	7–14D	7–14D	30D	30D	30D	15–30D	30D	30D	
Enlite	12M	4M	9M	9M	9M	12M	9M	30M	0	9M	4M	
Envive	12M	4M	12M	10M	18M	30M	12M	30M	0	10M	4M	
Eptam	AH	AH	AH	AH	AH	AH	AH	AH	AH	AH	AH	
Escort	BA	10M	BA	BA	BA	10M	BA	BA	BA	BA	1M	
Express	45D	0	45D	14D	14D	45D	45D	45D	45D	45D	0	
Extreme	4M	9.5M	4M	8.5M	18M	18M	4M	26M	0	9.5M	3M	<b>Field corn:</b> Imidazolinone-tolerant corn hybrids have no restrictions
Fierce EZ	10M	11M	18M	7–30D	18M	12M	11M	4M	0	12M	1–2M	
Fierce MTZ	10M	11–12M	9–11M	7–30D	4M	12M	2–4M	9M	0	12M	4–8M	<b>Wheat:</b> 4M interval if planted after peas or soybean.

Abbreviations: 0 = no restriction; M = month; AH = after harvest; D = day; Y = year; NA = not approved; NL = not listed; BA = bioassay required; FY = following year; — = no restrictions for rotational crops listed on label  
<sup>a</sup> See the label for information on crops not listed below

Continued on next page

Principles of pest management

Corn weeds

Soybean

Forages &amp; pastures

Small grains

Stored grain insects

Appendix

**Table 7-4.** Planting interval for rotational crops (continued)

Herbicide	Alfalfa <sup>a</sup>	Barley	Snap beans	Field corn	Sweet corn	Oats	Peas	Potato	Soybean	Tobacco	Wheat	Comments
Fierce XLT	18M	18M	18M	10M	18M	30M	18M	30M	0	18M	4M	
FirstRate	9M	12M	9M	9M	18M	9M	9M	18M	0	18M	4M	<b>Tobacco:</b> 10M interval for transplant tobacco after 0.3 oz/a or less
Flexstar	18M	4M	0	10M	10M	4M	10M	18M	0	18M	4M	
Flexstar GT 3.5	18M	4M	0	10M	10M	4M	4M	0M	0	18M	4M	
Fultime NXT	18M	18M	18M	0	0	18M	18M	18M	18M	18M	4M	
Fusilade DX	0	60D	0	60D	60D	60D	0	0	0	0	60D	
Fusion	0	60D	0	60D	60D	60D	0	0	0	0	60D	
GrazonNext HL	24M	12M	24M	12M	12M	12M	24M	24M	24	24M	12M	<b>Alfalfa, snap beans, peas, potato, soybean, and tobacco:</b> Bioassay required
G-Max Lite	2Y	2Y	2Y	0	0	2Y	2Y	2Y	FY	2Y	2Y	
Gramoxone SL	0	0	0	0	0	0	0	0	0	0	0	
Guardsman Max	2Y	2Y	2Y	FY	FY	2Y	2Y	2Y	FY	2Y	2Y	
Halex GT	10M	4.5M	18M	0	0	4.5M	18M	10M	10M	10M	4.5M	
Harmony Extra	45D	0	45D	45D	45D	0	45D	45D	45D	45D	0	
Harmony SG	45D	0	45D	0	45D	0	45D	45D	0	45D	0	
Harness	9M	FY	2Y	0	0	FY	2Y	FY	FY	FY	4M	
Harness MAX	10M	FY	18M	0	0	FY	18M	18M	10M	18M	4M	
Harness Xtra	2Y	18M	2Y	FY	FY	18M	2Y	2Y	FY	2Y	18M	
Harness Xtra 5.6L	2Y	18M	2Y	FY	FY	18M	2Y	2Y	FY	2Y	18M	
Hornet WDG	10.5M	4M	10.5–18M	0	10.5–18M	4M	10.5M	18M	10.5M	18M	4M	<b>Sweet corn:</b> 10.5M interval for hybrids listed on the supplemental label
Huskie	4M	7D	9M	4M	4M	30D	9M	9M	4M	BA	7D	
Huskie Complete	9M	9M	BA	9M	BA	9M	9M	18M	9M	BA	3M	<b>Alfalfa:</b> Tillage and 12 inches rainfall is required between application and seeding
Impact	9M	3M	9–18M	0	0	3M	9M	9M	9M	18M	3M	<b>Snap beans:</b> 9M if using 0.5 oz/a rate
Instigate	10M	9M	18M	0	10M	9M	18M	10M	10M	18M	4M	<b>Alfalfa:</b> 18M if less than 15 inches of rain
INTRRO	FY	FY	2Y	FY	FY	FY	2Y	2Y	0	2Y	FY	
Journey	36M	24M	18M	36M	36M	24M	36M	48M	18M	36M	12M	Intervals are for 12 oz/a rate <b>Alfalfa, field corn, sweet corn, peas, potato, and tobacco:</b> Bioassay required
Keystone NXT	2Y	18M	2Y	FY	FY	18M	2Y	2Y	FY	2Y	18M	

Abbreviations: 0 = no restriction; M = month; AH = after harvest; D = day; Y = year; NA = not approved; NL = not listed; BA = bioassay required; FY = following year; — = no restrictions for rotational crops listed on label

<sup>a</sup> See the label for information on crops not listed below

Continued on next page

Principles of pest management

Corn weeds

Soybean

Forages & pastures

Small grains

Stored grain insects

Appendix

**Table 7-4.** Planting interval for rotational crops (continued)

Herbicide	Alfalfa <sup>a</sup>	Barley	Snap beans	Field corn	Sweet corn	Oats	Peas	Potato	Soybean	Tobacco	Wheat	Comments
Keystone LA NXT	15M	15M	2Y	0	0	15M	2Y	15M	FY	15M	15M	
Lariat	FY	2Y	2Y	0	0	2Y	2Y	2Y	FY	2Y	2Y	
Laudis	10M	4M	10M	0	0	4M	10M	10M	8M	12M	4M	
Liberty 280 SL	6M	70D	6M	0	6M	70D	6M	6M	0	6M	70D	
Lorox	4M	4M	4M	4M	4M	4M	4M	4M	0	4M	4M	
Lumax EZ	18M	4.5M	18M	0	0	FY	18M	18M	FY	18M	4.5M	Only <b>corn or sorghum</b> can be planted the following year, if planted after June 1
Marvel	18M	4M	0	10M	10M	4M	10M	0	0	18M	4M	
Maverick	18M	18M	18M	0	0	18M	18M	18M	10.5M	18	4-6M	Soybean: 10.5M for soils greater than 2% OM and rainfall greater than 15 inches within 12 months of application or 12 months <b>Wheat:</b> 4M (14-24 fl oz/a); 6M (32 fl oz/a)
MCPA Amine	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	
MCPA Ester	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	NL	
Metribuzin	4M	4M	12M	4M	4M	12M	8M	12M	0	12M	4M	
Milestone	24M	12M	24M	12M	12M	12M	24M	24M	24M	24M	12M	<b>Alfalfa, snap beans, peas, potato, soybean, and tobacco:</b> Bioassay required
NorthStar	8M	8M	8M	14D	8M	8M	8M	8M	8M	8M	3-8M	<b>Wheat:</b> Use shorter interval for winter wheat, longer interval for spring wheat
OpTill	4M	9.5M	4M	8.5M	18M	18M	4M	26M	0-1M	9.5M	4M	
OpTill PRO	9M	9.5M	4M	8.5M	18M	18M	4M	26M	0-1M	9.5M	4M	<b>Soybean:</b> See label
Option	60D	60D	60D	7D	7D	60D	60D	60D	14D	60D	60D	
Orion	9M	14D	12M	3M	3M	14D	12M	9M	9M	12M	14D	
Outlook	FY	4M	FY	0	0	4M	FY	FY	0	FY	4M	
Overdrive	30D	30D	30D	30D	30D	30D	30D	30D	30D	30D	30D	
Permit	9M	2M	9M	1M	3M	2M	9M	9M	9M	2Y	2M	
Phoenix	—	—	—	—	—	—	—	—	—	—	—	
Poast Plus	0	30D	30D	30D	30D	30D	30D	30D	0	30D	30D	
Prefix	18M	4.5M	0	10M	10M	4.5M	12M	18M	0	18M	4.5M	<b>Succulent peas</b> are 4 months
Preview 2.1SC	12M	4M	18M	4M	18M	18M	18M	12M	0	12M	4M	
Princep	2Y	2Y	2Y	0	0	2Y	2Y	2Y	FY	2Y	2Y	

Abbreviations: 0 = no restriction; M = month; AH = after harvest; D = day; Y = year; NA = not approved; NL = not listed; BA = bioassay required; FY = following year; — = no restrictions for rotational crops listed on label

<sup>a</sup> See the label for information on crops not listed below

Continued on next page

**Table 7-4.** Planting interval for rotational crops (continued)

Herbicide	Alfalfa <sup>a</sup>	Barley	Snap beans	Field corn	Sweet corn	Oats	Peas	Potato	Soybean	Tobacco	Wheat	Comments
Prowl H2O	FY	FY	0	FY	FY	FY	0	0	0	0	4M–FY	<b>Wheat:</b> Use shorter interval for winter wheat, longer interval for spring wheat
Pursuit	4M	9.5M	4M	8.5M	18M	18M	4M	26M	0	9.5M	3M	<b>Field corn:</b> Imidazolinone-tolerant corn hybrids have no restrictions
Python	4M	4M	4M	0	10.5–18M	4M	4M	12M	0	9M	4M	<b>Sweet corn:</b> 10.5M interval for hybrids listed on the supplemental label
Raptor	3M	4M	0	8.5M	8.5M	9M	0	9M	0	9M	3M	<b>Potato:</b> 18M if less than 18 inches of rainfall or if soil pH less than 6.2
Realm Q	10M	9M	18M	0	10M	9M	18M	10M	10M	18M	4–9M	<b>Alfalfa:</b> 18M if less than 15 inches of rainfall <b>Wheat:</b> Use shorter interval for winter wheat, longer interval for spring wheat
Resicore/Resicore XL	10.5M	10.5M	18M	0	0	10.5M	18M	18M	10.5M	18M	4M	<b>Soybean:</b> 10.5M for soils greater than 2% OM and rainfall greater than 15 inches within 12 months of application or 12 months
Resolve Q	10M	9M	10M	0	10M	9M	10M	1.5M	10M	18M	3–9M	<b>Wheat:</b> Use shorter interval for winter wheat, longer interval for spring wheat
Resource	30D	30D	30D	0	30D	30D	30D	0	0	30D	30D	
Revulin Q	10M	4M	18M	0	0	8M	18M	10M	10M	18M	4M	
Roundup Power-MAX	0	0	0	0	0	0	0	0	0	30D	0	
Select 2EC/Max	0	30D	0	6–30D	30D	30D	0	30D	0	30D	30D	
Sequence	4M	4.5M	0	0	0	4.5M	0	0M	0	FY	4.5M	
Sharpen	6M	0	3M	0	2M	0	3M	6M	2–3M	6M	0	Intervals are for 3 oz/a rate and may vary for other rates
Solstice	10M	10M	18M	0	0	AH	18M	10M	10M	10M	4M	If applied postemergence after mesotrione only, corn can replanted the year following application
Sonic	12M	12M	30M	10M	18M	12M	30M	18M	0	30M	4M	<b>Field corn and sweet corn:</b> 18M if 6.5–8 oz applied to soil with 1.5% organic matter or less and pH greater than 7 <b>Snap beans and peas:</b> Bioassay required

Abbreviations: 0 = no restriction; M = month; AH = after harvest; D = day; Y = year; NA = not approved; NL = not listed; BA = bioassay required; FY = following year; — = no restrictions for rotational crops listed on label

<sup>a</sup> See the label for information on crops not listed below

Continued on next page

**Table 7-4.** Planting interval for rotational crops (continued)

Herbicide	Alfalfa <sup>a</sup>	Barley	Snap beans	Field corn	Sweet corn	Oats	Peas	Potato	Soybean	Tobacco	Wheat	Comments
Spartan	12M	4M	12M	10M	18M	12M	12M	12M	0	0	4M	
Spike	BA	BA	BA	BA	BA	BA	BA	BA	BA	BA	BA	
Starane	4M	0	4M	0	0	0	4M	4M	4M	4M	0	
Status	30D	30D	4M	7D	4M	30D	4M	4M	30D	4M	30D	
Steadfast Q	10M	8M	10M	0	10M	8M	10M	10M	15D	10M	4–8M	<b>Sweet corn:</b> Hybrids Merit, Carnival, and Sweet Success require 15M <b>Potato and tobacco:</b> 18M if soil pH greater than 6 <b>Wheat:</b> Use shorter interval for winter wheat, longer interval for spring wheat
Stinger	10.5M	0	18M	0	10.5M	0	18M	18M	10.5M	18M	0	<b>Soybean:</b> 18M if soil has less than 2% organic matter and rainfall is less than 15 inches
Storen	10M	11M	18M	0	0	11M	18M	10M	10M	18M	4.5M	<b>Alfalfa:</b> 10M rotation applies only when total rate was ≤ 2.1 qt/A and soil pH is >6.5 or a minimum of 18" of rain was received between application and alfalfa planting. Otherwise rotation interval in 18M. If applied after June 1, rotating to crops with 10 month intervals other than corn may result in crop injury
SureStart II	FY	FY	2Y	0	10.5–18M	FY	2Y	18M	FY	18M	4M	<b>Alfalfa:</b> Minimum rainfall of 15 inches required. <b>Soybean:</b> 18M if soil has less than 2% organic matter and rainfall is less than 15 inches
Surpass NXT	FY	FY	2Y	0	0	FY	2Y	FY	FY	FY	4M	
Surveil	30M	30M	9M	9M	18M	9M	9M	18M	0	30M	3M	<b>Alfalfa and barley:</b> Bioassay required
Synchrony XP	9M	3M	9M	9M	9–18M	3M	9M	30M	0	9M	3M	<b>Sweet corn:</b> 18M for rates over 0.375 oz/a
Tavium	6M	4.5M	6M	0	0	4.5M	6M	6M	28D	FY	4.5M	<b>Corn/Sweet Corn:</b> Application to coarse soils or soils with <2.5% organic matter under cool wet conditions may result in transient crop injury. <b>Soybean:</b> 0 days for dicamba-tolerant soybean

Abbreviations: 0 = no restriction; M = month; AH = after harvest; D = day; Y = year; NA = not approved; NL = not listed; BA = bioassay required; FY = following year; — = no restrictions for rotational crops listed on label

<sup>a</sup> See the label for information on crops not listed below

Continued on next page

Principles of pest management

Corn weeds

Soybean

Forages & pastures

Small grains

Stored grain insects

Appendix

**Table 7-4.** Planting interval for rotational crops (continued)

Herbicide	Alfalfa <sup>a</sup>	Barley	Snap beans	Field corn	Sweet corn	Oats	Peas	Potato	Soybean	Tobacco	Wheat	Comments
Tendovo	9M	12M	9M	9M	18M	12M	12M	18M	0	18M	4.5-9M	<b>Wheat:</b> Use shorter interval for winter wheat, longer interval for spring wheat
Treflan	5M	12M	0	12M	12M	12M	0	0	0	5M	12M	
Tripleflex II	FY	FY	2Y	0	10.5–18M	FY	2Y	18M	FY	18M	4M	<b>Alfalfa:</b> Minimum rainfall of 15 inches required. <b>Soybean:</b> 18M if soil has less than 2% organic matter and rainfall is less than 15 inches
Trivence	10M	4M	30M	10M	18M	18M	12M	30M	4M	18M	4M	<b>Tobacco:</b> As transplants
TriVolt	17M	12M	17M	0	9M	17M	17M	17M	9M	12M	4M	
Ultra Blazer	100D	40D	100D	100D	100D	40D	100D	100D	0	100D	40D	
Valor EZ	10M	4M	4M	7-30D	4M	10M	4M	10M	0	2M	1-2M	
Valor SX	10M	4M	4M	7-30D	4M	10M	4M	10M	0	2M	1-2M	
Valor XLT	12M	4M	4M	10M	18M	30M	12M	30M	0	10M	4M	
Velpar	2Y	2Y	2Y	12M	2Y	2Y	2Y	2Y	2Y	2Y	2Y	
Verdict	FY	4M	FY	FY	FY	4M	FY	FY	FY	FY	4M	
Vida	30D	30D	30D	0	0	30D	30D	0	0	30D	0	
Xtendimax	120D	15-30D	120D	120D	120D	15-30D	120D	120D	120D	120D	15-30D	Plantback is specific to the rate applied, see label
Warrant	9M	FY	FY	0	0	FY	FY	FY	0	FY	4M	Replanting of corn or soybeans may results in crop injury
Warrant Ultra	18M	4M	18M	10M	10-12M	4M	10M	18M	0	18M	4M	<b>Sweet corn:</b> See label
Weedmaster	4M	10D	4M	4M	4M	10D	4M	4M	4M	4M	10D	<b>Barley, oats, and wheat:</b> 10D per pint/a
Wolverine Advanced	4M	1M	BA	9M	9M	1M	9M	9M	4M	BA	1M	
Yukon	9M	2M	9M	1M	3M	2M	9M	9M	9M	2Y	2M	
Zidua	10M	11M	18M	0	0	11M	4-6M	4M	0-4M	18M	4-6M	

Abbreviations: 0 = no restriction; M = month; AH = after harvest; D = day; Y = year; NA = not approved; NL = not listed; BA = bioassay required; FY = following year; — = no restrictions for rotational crops listed on label

<sup>a</sup> See the label for information on crops not listed below

**Table 7-5.** Herbicide effectiveness on listed invasive weeds in CRP fields

Efficacy ratings: 10 = excellent; 8 = good; 6 = fair; 4 = poor; 0 = none; — = insufficient information

<sup>a</sup>Nonselective herbicide: will injure both grasses and broadleaf plants.<sup>b</sup>Restricted-use product in Wisconsin.

Commercial name	Active ingredient(s)	Burdock	Canada goldenrod	Chinese lespedeza	Common tansy	Crown vetch	Curly dock	Dames rocket	Field bindweed	Garlic mustard	Giant hogweed	Giant ragweed	Hawkweeds	Hill mustard	Japanese hedge parsley
2,4-D	2,4-D	9	7	4	8	7	7	8	6	6	5	8	7	8	—
2,4-D + glyphosate <sup>a</sup>	2,4-D + glyphosate <sup>a</sup>	9	—	—	8	—	—	—	7	—	—	7	—	—	—
Banvel	dicamba	8	7	4	8	8	7	8	7	6	5	7	7	—	—
Butyrac	2,4-DB	—	7	—	—	—	6	0	0	—	—	—	—	—	—
Chaparral	aminopyralid + metsulfuron	9	9	7	9	9	9	8	—	9	8	8	9	8	8
Cimarron Max	metsulfuron + 2,4-D + dicamba	9	9	8	8	8	9	—	7	—	—	6	—	9	—
Cimarron Plus	metsulfuron + chlorsulfuron	9	9	—	10	8	—	—	—	—	—	—	—	—	—
Crossbow	2,4-D + triclopyr	9	7	8	7	8	9	—	7	—	—	9	—	8	—
Curtail	2,4-D + clopyralid	8	6	—	8	8	6	—	—	—	—	8	7	—	—
DuraCor	aminopyralid + florypyrauxifen	9	5	4	4	10	9	—	—	—	8	8	10	—	—
Escort	metsulfuron	9	9	7	8	8	9	8	5	9	8	4	—	10	10
ForeFront HL	2,4-D + aminopyralid	9	7	4	7	10	9	—	—	—	—	10	10	—	—
Fusilade	fluazifop	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Garlon	triclopyr	9	7	9	4	9	7	8	6	8	8	9	—	8	8
Gramoxone SL <sup>a</sup>	paraquat <sup>a</sup>	5	4	4	4	4	4	4	4	5	4	5	4	4	5
Grazon P+D <sup>b</sup>	2,4-D + picloram <sup>b</sup>	10	8	4	8	10	10	—	8	—	—	10	8	—	—
Habitat <sup>a</sup>	imazapyr <sup>a</sup>	8	—	4	10	4	9	—	9	9	—	6	—	—	—
Journey <sup>a</sup>	imazapic+glyphosate <sup>a</sup>	—	4	4	6	4	7	—	7	9	—	7	—	—	—
MCPA	MCPA	—	0	—	4	4	7	—	5	—	5	—	7	—	—
Method	aminocyclopyrachlor	9	—	—	9	9	8	8	9	7	—	8	10	—	—
Milestone	aminopyralid	9	5	4	4	10	8	—	—	—	8	8	10	—	—
Oust <sup>a</sup>	sulfometuron <sup>a</sup>	—	8	—	—	8	7	—	—	9	—	—	—	—	—
Outrider	sulfosulfuron	—	—	—	6	—	—	—	—	9	—	—	—	—	—
Overdrive	dicamba + diflufenzopyr	8	7	4	8	4	9	—	8	6	—	7	—	—	—
Pastureguard	fluroxypyr + triclopyr	7	9	9	—	8	9	—	5	—	—	8	—	—	—
Perspective	aminocyclopyrachlor + chlorsulfuron	9	9	—	8	7	8	8	9	7	—	8	10	—	—
Plateau	imazapic	—	0	0	4	0	7	8	7	9	8	6	—	8	—
Poast Plus	sethoxydim	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pursuit	imazethapyr	—	—	—	—	0	7	—	4	—	—	7	—	—	—
Redeem	clopyralid + triclopyr	9	8	6	6	8	8	—	9	—	—	10	8	—	—
Roundup <sup>a</sup>	glyphosate <sup>a</sup>	8	8	6	6	6	9	8	7	9	9	7	—	9	8
Starane	fluroxypyr	—	—	9	—	—	8	—	6	—	—	—	—	—	—
Stinger	clopyralid	9	4	4	9	9	8	—	4	—	7	9	7	—	—
Streamline	aminocyclopyrachlor + metsulfuron	9	9	8	9	9	9	8	9	9	—	8	10	—	—
Telar	chlorsulfuron	8	8	—	—	—	7	8	—	—	—	—	—	—	—
Tordon <sup>b</sup>	picloram	9	9	6	8	10	9	—	7	—	—	10	7	—	—
Weedmaster	2,4-D + dicamba	8	8	5	9	9	9	—	7	6	—	10	—	7	—

Principles of pest management

Corn weeds

Soybean

Forages &amp; pastures

Small grains

Stored grain insects

Appendix

**Table 7-5.** Continued

Efficacy ratings: 10 = excellent; 8 = good; 6 = fair; 4 = poor; 0 = none; — = insufficient information

<sup>a</sup>Nonselective herbicide: will injure both grasses and broadleaf plants.

<sup>b</sup>Restricted-use product in Wisconsin.

Commercial name	Active ingredient(s)	Japanese knotweed	Knapweed spp.	Multiflora rose	Phragmites	Poison hemlock	Purple loosestrife	Queen Anne's lace	Reed canary grass	Spurge, leafy & cypress	Sweet clover, white & yellow	Teasel, cutleaf & common	Thistle, bull	Thistle, Canada	Thistle, marsh	Thistle, musk	Thistle, plumeless	Wild chervil	Wild parsnip
2,4-D	2,4-D	7	7	5	0	9	4	9	0	5	6	8	9	6	9	9	9	6	9
2,4-D + glyphosate <sup>a</sup>	2,4-D + glyphosate <sup>a</sup>	—	—	—	—	—	—	—	—	7	7	—	9	8	—	—	—	—	—
Banvel	dicamba	7	7	7	0	9	—	8	0	5	6	9	9	6	9	9	9	6	6
Butyrac	2,4-DB	—	—	—	—	—	—	—	0	—	0	—	—	—	—	—	—	—	—
Chaparral	aminopyralid + metsulfuron	9	10	9	0	9	9	10	0	—	9	9	10	10	9	10	10	9	9
Cimarron Max	metsulfuron + 2,4-D + dicamba	—	7	9	0	9	—	10	0	7	6	9	9	7	—	10	10	9	—
Cimarron Plus	metsulfuron + chlorsulfuron	—	—	7	—	9	—	9	0	—	6	9	9	8	—	9	—	9	—
Crossbow	2,4-D + triclopyr	5	7	8	0	7	—	8	0	6	7	9	9	6	9	9	9	5	8
Curtail	2,4-D + clopyralid	—	8	—	0	7	—	8	0	4	7	7	9	8	—	8	9	5	8
DuraCor	aminopyralid + florypyrauxifen	9	10	6	0	4	8	8	0	4	9	9	10	10	10	10	10	10	10
Escort	metsulfuron	—	6	8	0	9	8	10	0	—	6	9	8	7	8	9	9	9	10
ForeFront HL	2,4-D + aminopyralid	—	10	7	0	9	8	8	0	4	9	4	9	10	—	10	9	—	8
Fusilade	fluazifop	0	0	0	7	0	0	0	9	0	0	0	0	0	0	0	0	0	0
Garlon	triclopyr	7	5	7	0	9	6	8	0	5	6	9	9	6	9	7	9	6	6
Gramoxone SL <sup>a</sup>	paraquat <sup>a</sup>	4	4	4	4	5	—	5	4	4	5	4	5	4	5	5	5	4	4
Grazon P+D <sup>b</sup>	2,4-D + picloram <sup>b</sup>	—	7	8	0	9	—	8	0	9	9	9	10	9	—	10	10	—	8
Habitat <sup>a</sup>	imazapyr <sup>a</sup>	9	7	8	9	8	10	9	9	8	5	9	8	6	8	7	8	9	—
Journey <sup>a</sup>	imazapic + glyphosate <sup>a</sup>	6	6	4	6	8	—	9	9	9	0	8	9	4	—	7	—	7	6
MCPA	MCPA	—	—	—	0	7	—	—	0	—	5	—	—	—	—	—	—	—	—
Method	aminocyclopyrachlor	7	—	9	0	8	—	10	0	9	9	9	10	10	—	10	10	10	10
Milestone	aminopyralid	9	10	6	0	4	8	6	0	4	9	9	10	10	10	10	10	—	6
Oust <sup>a</sup>	sulfometuron <sup>a</sup>	—	7	—	—	9	—	—	9	5	6	9	—	8	—	8	—	—	—
Outrider	sulfosulfuron	—	—	—	—	—	—	—	—	—	—	4	—	—	—	—	—	—	—
Overdrive	dicamba + diflufenzopyr	6	9	—	—	9	—	9	—	—	4	9	9	8	—	9	9	—	8
Pastureguard	fluroxypyr + triclopyr	—	4	8	—	9	—	6	—	—	6	9	4	4	—	4	4	—	—
Perspective	aminocyclopyrachlor + chlorsulfuron	7	10	9	4	8	—	10	4	9	9	10	10	10	—	10	10	9	10
Plateau	imazapic	4	6	0	4	8	—	9	9	8	0	8	6	4	—	6	—	6	4
Poast Plus	sethoxydim	0	0	0	4	0	0	0	9	0	0	0	0	0	0	0	0	0	0
Pursuit	imazethapyr	—	—	—	—	—	—	—	6	—	0	—	—	4	—	—	—	—	—
Redeem	clopyralid + triclopyr	—	9	4	0	9	—	9	0	4	8	9	9	7	—	9	9	—	6
Roundup <sup>a</sup>	glyphosate <sup>a</sup>	7	9	8	9	7	7	9	9	6	5	9	9	8	7	9	9	8	9
Starane	fluroxypyr	—	—	—	—	—	—	—	—	4	6	—	—	—	—	—	—	—	—
Stinger	clopyralid	—	9	4	0	9	—	4	0	4	9	8	10	9	8	10	10	6	6
Streamline	aminocyclopyrachlor + metsulfuron	—	10	9	4	9	—	10	4	9	9	10	10	10	—	10	10	9	10
Telar	chlorsulfuron	—	—	7	—	8	—	9	0	—	6	8	9	7	9	9	9	8	9
Tordon <sup>b</sup>	picloram	8	9	8	0	9	—	8	0	8	8	9	10	8	10	10	10	—	—
Weedmaster	2,4-D + dicamba	—	9	6	0	9	—	9	0	5	6	9	9	7	—	9	9	—	9

This table is also published as *Herbicide Effectiveness on Invasive Plants in Wisconsin* (A3893). To order a sturdy 11" x 17" chart or to download a PDF, go to [learningstore.uwex.edu](http://learningstore.uwex.edu).

Principles of pest management

Corn weeds

Soybean

Forages &amp; pastures

Small grains

Stored grain insects

Appendix

## Useful UW-Madison, Division of Extension publications

The following publications may be purchased from online at [learningstore.extension.wisc.edu](http://learningstore.extension.wisc.edu) or call toll-free 877-WIS-PUBS (947-7827).

### University of Wisconsin-Madison websites

Division of Extension agriculture:  
[extension.wisc.edu/agriculture/](http://extension.wisc.edu/agriculture/)

Soybean and Small Grains:  
[coolbean.info](http://coolbean.info)

Entomology Department:  
[insectlab.russell.wisc.edu](http://insectlab.russell.wisc.edu)

Field Crop Pathology:  
[badgercropdoc.com](http://badgercropdoc.com)

Pesticide applicator training:  
[fyi.extension.wisc.edu/pat/](http://fyi.extension.wisc.edu/pat/)

Plant Disease Diagnostics Lab  
[pddc.wisc.edu](http://pddc.wisc.edu)

Weed Science:  
[wiscweeds.info](http://wiscweeds.info)  
[weedid.wisc.edu](http://weedid.wisc.edu)

Plant and Agroecosystem Sciences Department:  
<https://pasdept.wisc.edu/>

The Integrated Pest and Crop Management website:  
[ipcm.wisc.edu](http://ipcm.wisc.edu)

*Home of the Nutrient and Pest Management (NPM) Program, Integrated Pest Management (IPM) Program and the Wisconsin Crop Manager.*

### Corn and soybean

*Corn Earworm* (A3655)

*Corn Fertilization* (A3340)

*Corn Replant/Late-Plant Decisions in Wisconsin* (A3353)

*Corn Rootworms* (A3328)

*Corn Silage Production, Management, and Feeding* (NCR574)

*European Corn Borer* (A1220)

*Herbicide Persistence and Carryover* (A3819)

*Herbicide Resistance Management in Vegetable Rotations—poster* (A3822)

*Insect Resistance Management and Refuge Requirements for Bt Corn* (A3857)

*Moth Identification Guide for Blacklight Trap Catch in Wisconsin* (A3855)

*Protect Your Corn from Cranes* (A3897)

*Seed Corn Maggot* (A3820)

*Two-spotted Spider Mite Management in Soybean and Corn* (A3890)

*Uneven Emergence in Corn* (NCR344)

*Western Bean Cutworm: A Pest of Field and Sweet Corn* (A3856)

### Forages and small grains

*Alfalfa Germination and Growth* (A3681)

*Alfalfa Management Guide* (NCR547)

*Alfalfa Stand Assessment: Is This Stand Good Enough to Keep?* (A3620)

*Buying Horse Hay* (A3772)

*Determining Pasture Condition* (A3667)

*Forage Variety Update for Wisconsin* (A1525)

*Identifying Pasture Grasses* (A3637)

*Identifying Pasture Legumes* (A3787)

*Pastures for Horses: A Guide to Rotational Grazing—CD* (A3764)

*Pastures for Profit: A Guide to Rotational Grazing* (A3529)

*Toxic Plants in Midwest Pastures and Forages* (A4019)

*Wisconsin Oats and Barley Performance Tests* (A3874)

### Weed management

*Common Weed Seedlings of the North Central States* (NCR607)

*Herbicide Effectiveness on Invasive Plants in Wisconsin* (A3893)

*Management of Invasive Plants in Wisconsin (set)* (A3924-set)

*Weed Identification and Management—DVD* (A3829)

**Copyright © 2024** by the Board of Regents of the University of Wisconsin System doing business as the University of Wisconsin–Madison Division of Extension. All rights reserved.

**Authors:** Ryan Dewerff is weed science research specialist in plant and agroecosystem sciences, Emily Bick is assistant professor of entomology, Patrick J. Liesch is assistant faculty associate of entomology, Glenn Nice is pesticide applicator training (PAT) program manager, Mark Renz is associate professor of agronomy, Damon Smith is assistant professor of plant pathology, and Rodrigo Werle is associate professor in plant and agroecosystem sciences. All hold joint appointments with the College of Agricultural and Life Sciences, University of Wisconsin–Madison and University of Wisconsin–Madison Division of Extension. Division of Extension publications are subject to peer review.

**University of Wisconsin–Madison Division of Extension**, in cooperation with the U.S. Department of Agriculture and Wisconsin counties, publishes this information to further the purpose of the May 8 and June 30, 1914, Acts of Congress. An EEO/AA employer, the University of Wisconsin–Madison Division of Extension provides equal opportunities in employment and programming, including Title VI, Title IX, and ADA requirements. If you have a disability and require this information in an alternative format, or if you would like to submit a copyright request, contact Division of Extension Publishing at 702 Langdon St., L50 Pyle Center, Madison, WI 53706; [pubs@extension.wisc.edu](mailto:pubs@extension.wisc.edu); or (608) 263-2770 (711 for Relay).

**This publication is available** from your Wisconsin county Extension office ([counties.extension.wisc.edu](https://counties.extension.wisc.edu)) or from Division of Extension Publishing. To order, call toll-free 1-877-947-7827 or visit our website at [learningstore.extension.wisc.edu](https://learningstore.extension.wisc.edu).

## Pest Management in Wisconsin Field Crops — 2024 (A3646)

R-11-2024-1M

